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ROADS AND STREETS

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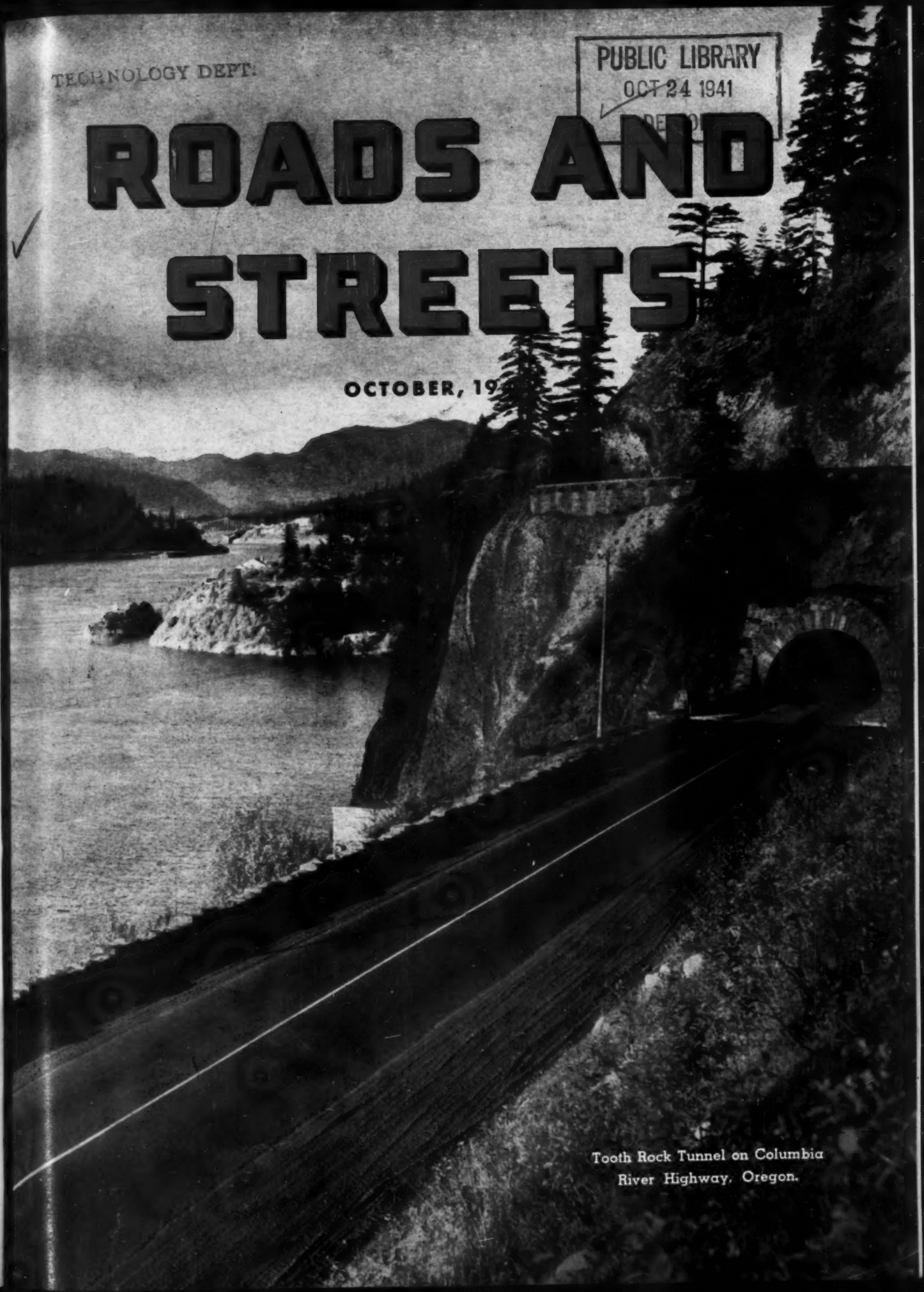

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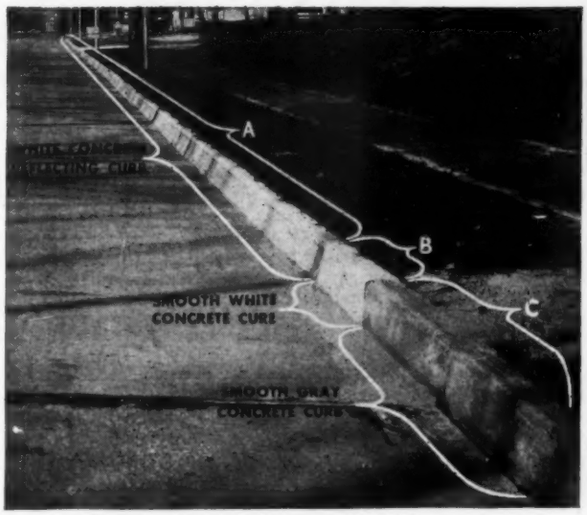
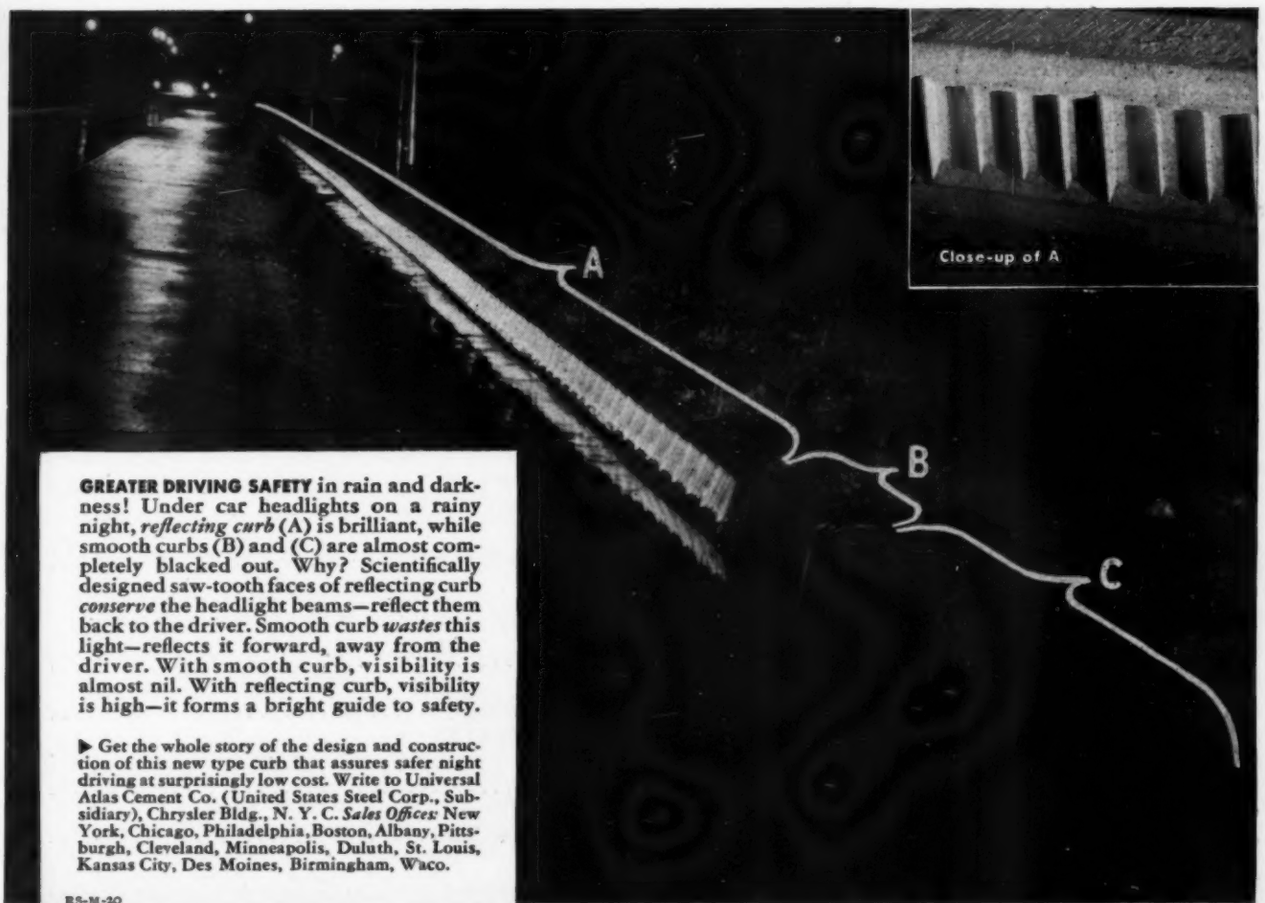


Reflecting white **concrete curb (A),** ***smooth white*** **concrete curb (B), and** ***smooth gray*** **concrete curb (C), at one New Jersey location. In the night photograph below, note the great difference in visibility of the three curbs under car headlights on a rainy night. Contractor, Jannarone Contracting Co., Belleville, N. J.; Curb Contractor, Frapaul Construction Co., Inc., Hackensack, N. J.**



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ROADS and STREETS

Vol. 84, No. 10 October, 1941

A GILLETTE PUBLICATION
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NEW STRENGTH DESIGN FOR CONCRETE PAVEMENT MIX

Field Control is Important Part of Texas' Design and Construction Procedure

By VICTOR J. BROWN
Publishing Director
ROADS AND STREETS

CONCRETE pavement construction procedure is governed by specifications which are prepared so as to interpret fundamental concrete mixtures theories as well as good construction practice. After compliance with theory and specification comes economics of plant setup, economics of materials supply, and the many other competitive labor and cost reducing procedures. In Williamson County, Texas, on U. S. 81, north of Round Rock, George Kess, Inc., Austin, Tex., the contractor, is building a pavement according to Texas' new concrete procedure, strength design. The job is a 24 ft. pavement, 7.633 miles long. It is reinforced as shown in pictures herewith and is being laid at the rate of approximately 1300 ft. per day.

The important features of the job is the theory of strength design employed and the field control procedure required to guarantee satisfactory results. Contractors gladly accept this procedure because of the many advantages listed in the following explanation of the method.

General Summary of Design and Construction Procedure

The Texas Highway Department has two primary aims in the design and construction of concrete pavements. The first aim has been to secure concrete pavement of the proper quality for the required service and the second aim has been to secure maximum economy in obtaining pavement of the quality selected. Pavement of the proper quality must have strength sufficient to resist stresses due to loads, stresses due to restrained warping, etc., and durability sufficient to resist weathering, including freezing and thawing, etc. To secure maximum economy it is necessary that the specifications, the design and the control of paving mixtures be such that the contractor may select materials, equipment and methods which will result in the greatest possible saving.

Two general concrete paving specifications are employed. The first is termed a modified water-cement ratio specification where both the minimum cement factor and maximum water-cement ratio are specified. This type of specification has been used primarily on federal projects since the Public Roads Administration has heretofore questioned the advisability of a strength specification without specifying limits on the cement factor and water-cement ratio. At the present time the strengths obtained are always considerably in excess of the requirements. This type of specification is not economical because it does not permit the contractor to take advantage of the quality of his materials.

General View of the Plant With Cement Bin on the Left, the Fine Sand Bin in the Middle, and the Gravel and Sand Bin on the Right

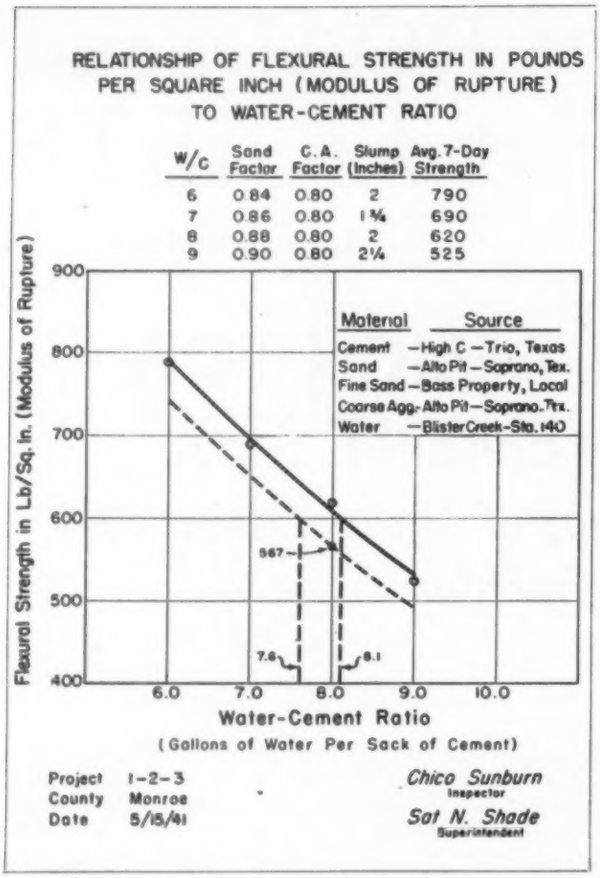


Fig. 1.—Relationship of Sand Factor to Water Cement Ratio as Determined by Small Trial Mixes

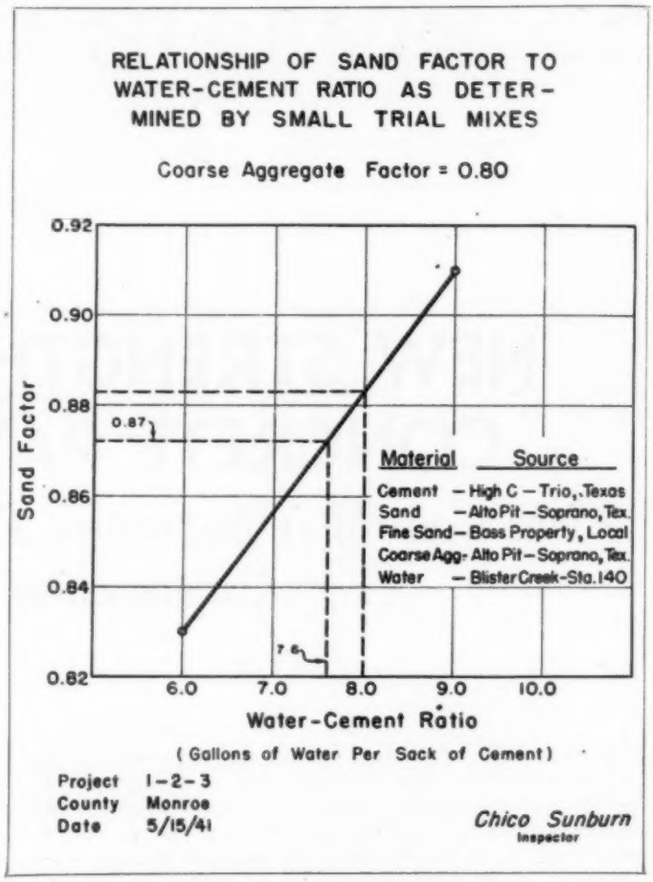


Fig. 2.—Relationship of Flexural Strength in Pounds Per Square Inch (Modulus of Rupture) to Water-Cement Ratio

Strength Design

The second type of specification under which the Texas Highway Department operates is a strength specification. This type of specification places no limit either on the cement factor or the water-cement ratio. The concrete is designed for the specified modulus of rupture of beams at the age of seven days and the durability is assured by the use of sound aggregates and as a result of dense concrete. The proper water-cement ratio is determined from preliminary or pilot tests employing the cement and aggregates as proposed for use on the particular project. These preliminary tests are necessary before the actual construction begins and may be divided into two subdivisions, the first being to determine the proper range of sand factors and coarse aggregate factors for the water-cement ratios chosen for the pilot beam tests in order to comply with the specification limitations on workability and consistency. These trial mixes consist of small concrete mixes. For these trial mixes only two water-cement ratios are selected, one well above and one well below the estimated water-cement ratio for the required strength. Small mixes are made by hand, varying the sand factor for each of the selected water-cement ratios until a concrete is secured having the specified slump and satisfactory workability and plasticity. The sand factor is increased as the water-cement ratio is increased in order to maintain the proper plasticity and consistency desired in the mortar.

The second step is to determine the proper water-cement ratio to give the strength required in the specifications. Using the proportions determined from the trial mixes, large mixes are made in a standard concrete paver and the slump (see fig. 7) and workability of the concrete are checked in accordance with the specification requirements. At least twenty standard beams (see fig. 6) are made for each of the selected water-cement ratios. The beams are cured in water at the specified temperature at the field laboratory (see fig. 4) and tested flexurally at the age of seven days by means of a center point loading on an 18-in. span. From these preliminary tests the sand factor limits and coarse aggregate factor limits are established for each water-cement ratio to produce concrete of the consistency and workability desired. A graph is platted, figure 1, which indicates the sand factor as the ordinate and the water-cement ratio as the abscissa. A second graph, figure 2, is platted which indicates the flexural strength in pounds per square inch as the ordinate and the water-cement ratio as the abscissa. As the construction progresses, job beams are made and the water-cement ratio is checked by averaging the flexural strengths of ten consecutive job beams. If the average strength of the ten consecutive flexural strength tests falls outside of the 25 pound band, above or below the designed strength, a new curve is drawn parallel to the original pilot beam curve and through the new point and the water-cement ratio is adjusted in order to secure concrete of the specified modulus of rupture as established by the specifications. With constant design factors the cement factor is a function of the voids in the coarse and in the fine aggregates, increasing as the voids increase unless the factors used in the design are modified. It is apparent that the cement factor is a function of both the sand factor and the coarse aggregate factor and the cement factor decreases as either or both of these factors in-

crease. It is imperative to adjust the sand factor and the coarse aggregate factor within the established range for these factors in order to realize the greatest economy with the materials available consistent with proper workability.

Employs Absolute Volume.—The absolute volume design used by the Texas Highway Dept. is not new to engineers, however, the procedure followed in their design employs certain factors which allows the engineer more latitude in his design changes. This method does not necessitate trial mixes being made during construction and eliminates the hazard of unsatisfactory and unworkable batches resulting from insufficient design data.

The design factors may be referred to as tools which are employed in arriving in the optimum amount of fine aggregate to be used with the water and cement to obtain mortar of the proper consistency, and the optimum amount of gravel that may be used to produce concrete of the desired consistency and workability. This permits the use of the maximum quantity of these materials and results in the most economical batch possible. By this method of design, concrete of a definite yield per sack of cement is assured at all times.

The design factors and the aggregate voids or solids are employed to proportion the ingredients in a batch, and the aggregate characteristics, such as the specific gravity and free moisture or absorption content, are employed to convert the various absolute volumes to the respective batch weights.

Field Control.—The engineering control of projects using the Texas Highway Dept. method of design and strength specification is outlined in detail further on in this article. Emphasis must be placed on the necessity for a trained personnel on projects constructed under this method of design and control. Texas has conducted training schools for concrete inspectors to familiarize them with their procedure and on each concrete paving project the Department places a chief paving inspector, a plant inspector, a mixer inspector and a surface inspector. The chief inspector correlates all of the design and control procedures under the direction of the resident engineer assigned to the project. The plant inspector designs all of the mixes and makes all of the necessary tests for control. He works in very close cooperation with the mixer inspector who keeps him informed as to the workability and consistency of the paving mix at all times. The mixer inspector is responsible for seeing that the mix meets the specifications for workability and advises with the plant inspector relative to design changes. The surface inspector checks the forms, subgrade cross-section, makes depth test determinations, gauges the surface of the concrete, and supervises the finishing and curing operations. This employee works under the direction of the mixer inspector.

A very detailed field laboratory report is prepared covering each day's operation. The data for this report are furnished by the mixer inspector, surface inspector and plant inspector from their daily paving reports. It is possible from these daily reports to analyze any completed concrete paving project and determine the exact materials and proportions used on any section of completed highway. Engineers still have occasion to refer to these reports on projects that have been completed from eight to ten years.

Design of Mix

Preliminary to a discussion of the theory and mechanics of the design of the mixture let us establish a few general criteria or controls for concrete paving. From experience and studies of field performance it has been learned that, generally speaking;

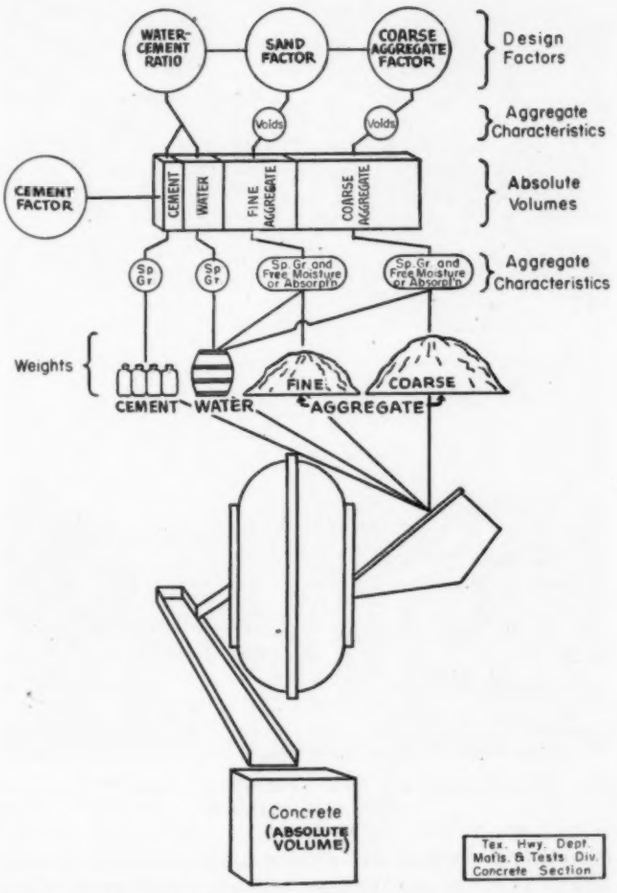


Fig. 3.—Schematic Diagram of Fundamental Procedure of Absolute Volume Design

First, The denser the concrete, the better its field service.

Second, The stronger the concrete, the better its field service.

Third, With a given set of aggregates and a given cement the water-cement ratio is a gauge of strength.

Fourth, Workability must be obtained without honeycombing in order to get a smooth, tight, even finish.

Fifth, Maximum economy is desirable.

Sixth, The mixture should contain the least amount of water possible per cubic yard and still produce satisfactory workability.

Seventh, The concrete must be uniform in quality as well as in workability.

Eighth, To secure maximum economy it is necessary that the specifications, the design, and the control of paving mixtures be such that the contractor may select materials, equipment, and methods which will result in the least cost to him to produce concrete in place, consistent with required strength.

The governing factors in designing concrete mixtures under the strength specification for concrete paving are as follows:

A—The specified minimum average flexural strength of the concrete must be obtained.

B—The maximum net gallons of water per sack of cement allowed by the specifications must not be exceeded.

C—The concrete must be uniform in quality and workability and the slump maintained within the limits set out in the specifications.

Economy of Gradation.—From the point of view of economy it must be always kept in mind that the abso-

Fig. 4.—Mixer and Laboratory at Plant

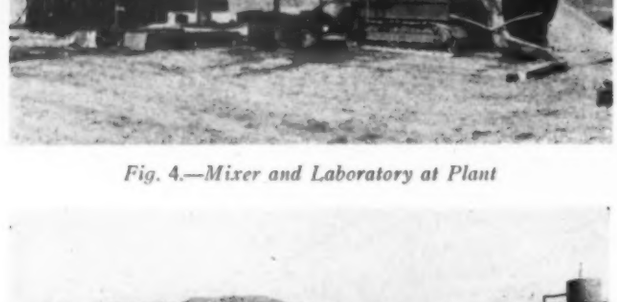


Fig. 5.—Pilot Beams and Paver at the Plant. Curing Vat Is Under Shed in Background

lute volume method of mixture design is largely a voidage proposition and the state highway department is just as much concerned in reducing voidage, i.e., in employing low void aggregates as is the contractor. The highway department under the strength specification type of mix design can design a mix of given strength out of *any combination of aggregates.* They have learned from experience; however, that a "gap grading" in the coarse aggregate produces the greatest density in the coarse aggregate and also produces concrete of satisfactory workability. By "gap grading" is meant the aggregates have a greater percentage of top and bottom sizes and very little intermediate sizes. Some contractors have bought aggregates of which the lowest voidage had the following analysis:

50 per cent of 2½ in. to 1¼ in. size.
0 per cent of 1¼ in. to ¾ in. size.
50 per cent of ¾ in. to ¼ in. size.

This is a gap graded material. Seldom, however, is the intermediate grade missing entirely. The contractor desires to purchase his aggregate on the basis of the lowest voidage he can get provided that the low voidage is not produced by a preponderance of the smaller sizes. For maximum economy he must not only get low voids but he must have as much of the larger sizes of coarse aggregate as is consistent with good workability of the concrete.

Once the supply has been started in stockpile, the contractor is not permitted to change the uniformity of the supply or the source without approval of the state highway department. If he intends to change his source of supply the state must run pilot beam tests on the proposed materials first and this procedure requires at least a week.

Strength Specification Restricted.—Texas is the only state in the Union, which is allowed by the Public Roads Administration to use a strength specification on Federal Aid Work. Approval was given last April, provided the 7-day flexural strength be maintained at a minimum average of 600 lb. per sq. in., and with 8.0 gal. of water per sack of cement.

While this is not completely a straight strength design, it is nearly so and will be so considered. The limitations placed by the Public Roads Administration hinders maximum economy for certain conditions, only. Based on their past experience, however, the Public Roads Administration believes that desirable concrete for strength, stress resistance, wear, and field service in Texas should have a water-cement ratio of 8.0 or less and a flexural strength (modulus of rupture) of 600 lb. per sq. in.

Absolute Volume Design.—In this explanation two of Texas' terms should be defined.

1. *The Coarse Aggregate Factor.* This is the ratio of the volume of coarse aggregate measured in a saturated, surface-dry, and loose condition to the absolute volume of the concrete in which the coarse aggregate is used. The coarse aggregate factor is, therefore, the bulk volume of coarse aggregate per unit volume of concrete. This term is identical with the Talbot-Richart term of b/b_o.

2. *Sand Factor.* This is the ratio of the volume of fine aggregate measured in a saturated, surface-dry, and loose condition to the absolute volume of mortar in which the fine aggregate is used. The sand factor is therefore the bulk volume of fine aggregate per unit volume of mortar.

In the absolute volume design one cubic foot of water is assumed to measure 7½ gals. weighing 62½ lb. One gallon of water is assumed to weigh 8.33 lb.

Explanation of Figure 3.—For convenience the factors which enter mix design will be separated into two main groups. One group includes specific gravity, per cent voids, per cent solids, free moisture and absorption. In a given stockpile the aggregate, whether coarse or fine, has a definite specific gravity, a definite voidage, and at the time the mix is designed, a definite free moisture or absorption content. Thus in designing a mix these factors are represented by fixed values which, inherent to the aggregate, cannot be changed. These factors have been labeled "aggregate characteristics."

The other group of factors includes water-cement ratio, coarse aggregate factor, and sand factor. In mix design these are varied for strength, workability, and economy. These factors are labeled, "design factors."

On this job only the flexural strength and workability

Fig. 6.—Making Pilot Test Beams for the W/C vs. Strength Curve. Note Beam Breaking Machine in Background

of the concrete are specified with the provision that the net water-cement ratio shall not exceed 8 gal. per sack of cement. The water-cement ratio required to produce 600 lb. sq. in. flexural strength concrete is ascertained from tests and the sand factor is varied to maintain the proper workability. By this method of mixture design the water-cement ratio, the coarse aggregate factor, and the sand factor must be known. The cement factor is unknown. The problem is to find the weights of the different ingredients required to produce a definite volume of concrete and the most economical mix.

Figure 3 illustrates the following explanation which is a synopsis of the one fundamental procedure of absolute volume design. The mix design involves only three major steps:

1. The design factors and the aggregate voids or solids are employed to proportion the ingredients by absolute volume for one sack batch.
2. The aggregate characteristics other than voidage are employed to convert the various absolute volumes to the respective batch weights.
3. The batch weights for a one sack design are increased or decreased to produce the desired absolute volume of concrete.

After the mixture is designed the job is started and an important feature of the method is the "job control." This will be discussed later. Pictures accompanying this article show the several procedures involved both in design and in job control.

Preliminary Field Work.—The many varying types of aggregates, as well as the possibility of combinations of these types, together with the types of cements available, prevent making mix design tests to determine the proper water-cement ratio *before* receiving bids on the project. Under a strength specification the contractor is permitted to use any combination of acceptable aggregates that will produce concrete of the required flexural strength and workability.

All materials used under this specification are tested and approved before being placed in the completed work. Mix design tests are run on materials approved for the project.

Before the mix design tests are run, it is necessary that the contractor provide, in addition to the necessary materials, an approved mixer, aggregate batching plant, field laboratory, curing vat., etc., as shown by figures 4 and 5, together with the necessary labor for making the concrete. The mix design tests require a minimum of four batches of the size to be used in the paving operations in addition to the materials required for the small hand mixed batches made in the laboratory. The tests are run in the presence of the contractor's superintendent and the contractor has the privilege of submitting any mix design upon which he desires tests to be made. It is the contractor's responsibility to see that the beams are properly protected and cured in the field before they are moved to the curing tank.

The mix design tests are dual in nature in that a series of small hand mixed trial batches are first made to determine the proper sand factor for the various water-cement ratios used in the large mix design tests. This series eliminates or reduces to a minimum the number of large size batches that must be wasted due to lack of workability. From this series of tests a sand factor-water-cement ratio graph, figure 1, is produced which is used as a guide when computing the mix design test batches. The second and concluding series of tests are flexural strength (modulus of rupture) tests made on concrete test beams cast of concrete with various water-cement ratios. The size of

Fig. 7.—Determining Slump, 2¼ in. Required on This Job

the batches of concrete mixes used in casting the test specimens is the same as that proposed for use during construction. From the results of the flexural strength tests a flexural strength curve, figure 2, is produced which is used to start paving and as a guide to control of the mix during construction or as long as the character of the materials remain the same.

Explanation Continued.—In the article immediately following, explanation of the design and construction procedure employed on the Williamson County job is continued. This article is broken into two parts for convenience.

CONVEYOR PLACES EARTH INSIDE IGLOO FOR CURING CONCRETE

Hunkin-Conley Construction Co., Cleveland, O., general contractor for the huge Ravenna, O., ordnance plant for loading shells, uses a Barber-Greene portable belt conveyor to place earth inside an "igloo" for curing the concrete structure. Trucks bring the earth to the hopper end of the conveyor for transport inside the structure.

Hundreds of these igloos are used at the various ordnance plants for storing live shells, etc. Their design was developed by army engineers, special features of which are military secrets.

Belt Conveyor Carrying Earth Inside Igloo

PAVING CONTRACTOR PROFITS BY TEXAS STRENGTH DESIGN

Required Strengths Were Exceeded and "Gap Graded" Aggregate Was Used with Economy

By VICTOR J. BROWN
Publishing Director
ROADS AND STREETS

IMMEDIATELY preceding is the first part of this article which was broken into two parts for convenience and ease in reading. The project on which this strength design procedure was used is U. S. 81 north of Round Rock, which is north of Austin, Texas. It is a 24 ft. concrete paving job built by George Kies, Inc., of Austin, Tex. The previous article dealt with general information and preliminary work. This article deals with the mechanics of mix design and job control.

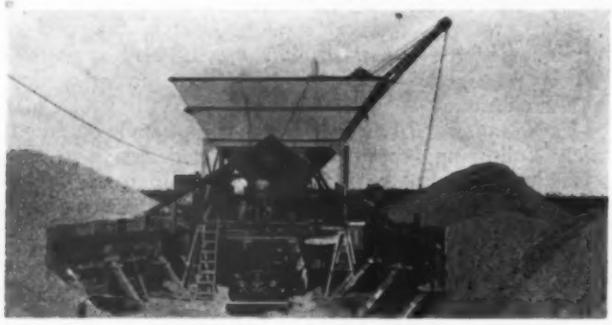


Fig. 8.—Blaw-Knox Gravel and Sand Bin. Note Awning Protecting Operator. Bin Is Located Directly Between Aggregate Piles

Fig. 9.—Butler Bulk Cement Type Mechanical Cement Batcher Was Used on This Job

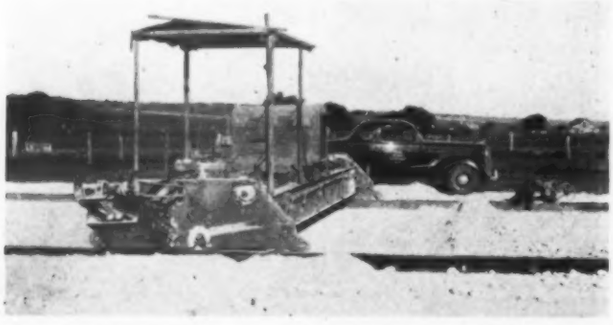


Fig. 10.—Flynn Surgrader and Lakewood Mechanical Form Tamper Prepare Line and Grade

Mix Design Tests

The first step in determining the water-cement ratio that would produce concrete with a specified flexural strength was to select sand factors that with a given coarse aggregate factor and water-cement ratios of 6 and 9 gallons of water per sack of cement would produce concrete that meets the specified requirements for workability and slump. The second step was to determine the water-cement ratio which would produce concrete with the specified flexural strength. This determination was made by means of flexural strength tests made on concrete test beams cast from full size batches, see figure 5. The proportions of the batches were calculated using the previously determined sand factors.

Sand Factor Tests.—The first series of tests consisted of making small trial batches of concrete using the water-cement ratios of 6 and 9 gallons of water per sack for the purpose of determining the sand factor that would produce a concrete of the desired workability and slump.

These trial mixes were made by preparing a 0.25 cu. ft. batch by hand in a large pan. Slump was measured and the plasticity and workability observed. If the mixture is plastic and cohesive, and the slump is within the specified limits, the mixture may be considered workable. The engineer takes into account the fact that the slump of a large, machine-mixed batch is always greater than that of a small hand-mixed batch by approximately ½ inch. In workable concrete the mortar will cling to the bottom of a trowel which is pressed on the surface and then pulled away. When the mixture appears to be liquid and the mortar is thin,

Fig. 11.—Carr Subgrade Planer Pulled by a Ford Tractor for Finishing Fine Grade

Fig. 12.—Subgrade with Reinforcing Steel in Place. Note That Only Circumferential Steel Is Employed

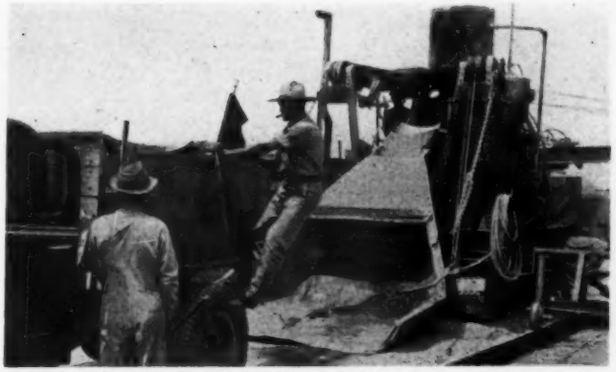


Fig. 13.—Paving Inspector Securing Flag from Haul Trucks. Attached to Flag Is a Note from Plant Changing Batch Design

it indicates that the sand factor is too low and that there is an excess of paste. To correct this condition the amount of paste is reduced by using a higher sand factor. In some cases it becomes necessary to observe the workability of several mixes before the correct sand factor is determined.

Trial mixes employing two water-cement ratios were made. The first was designed using a coarse aggregate factor of 0.80, (sometimes up to 0.82 is used) a sand factor of 0.84 (this sand factor is an arbitrary value and is taken as a starting point), and a water-cement ratio of 6 gal. per sack. In the workability or slump is not satisfactory, a change is made in the sand factor and another mix prepared. This procedure was continued until a sand factor was found that produced concrete having the desired workability and slump. The procedure was repeated using a coarse aggregate factor of 0.80, a water-cement ratio of 9 gal. per sack, and a sand factor of 0.90, as a starting point. The coarse aggregate factor is not critical insofar as workability is concerned and the value 0.80 was used in the tests because it is the average of the values most commonly used.

After selecting the proper sand factors for the 6. gal. and the 9 gal. water-cement ratios, a graph, figure 1, was prepared by plotting these water-cement ratios against the sand factors. The proper sand factor for any intermediate water-cement ratio may be determined from a straight line drawn through these two plotted points.

Water-Cement Ratio Tests.—The second series of tests consisted of designing mixes and preparing batches and tests beams, and testing the beams, for the purpose of determining the water-cement ratio and the mix proportions that would produce concrete of the specified flexural strength and workability. The mixes were designed employing water-cement ratios of 6, 7, 8, and 9 gal. per sack with the proper sand factor as determined above and a coarse aggregate factor held constant at 0.80. Tests beams for twenty flexural tests were made for each of the four mixes.

These batches were mixed in the paver approved for the job, see figure 6, and were the same size as used in actual paving operations. A batch of the lower water-cement ratio was run through the paver and wasted, in order to coat the drum and blades thoroughly. The slump and workability of this batch was checked so that if the batch was harsh, or if the slump was not within the specified limits, appropriate changes could be made before another batch was mixed. Test specimens are never made from a batch which does not meet workability and slump requirements.

When the slump and workability requirements were satisfied, specimens for twenty flexural strength tests

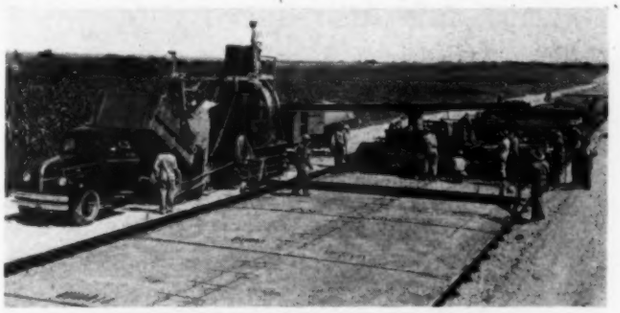


Fig. 14.—General View of Paving Operations Showing Compact Unit Obtained by Good Management

Fig. 15.—Roll of Concrete in Front of Finishing Machine. Note Workability of Mix Next to Screed

were made. This operation was continued until specimens for twenty flexural tests were made from each of the four water-cement ratios. These specimens were cured according to specifications and tested at the age of seven days.

After the beams were tested the average flexural strength was calculated on the basis of twenty tests for each mix design. All values which varied from this average by more than 15 per cent were eliminated and the remaining values averaged. The average flexural strength obtained in this manner for each water-cement ratio was plotted against the water-cement ratio and a smooth curve produced as illustrated in figure 2. All points are given equal weight when drawing this curve provided no single point is obviously out of line with the results reflected by the remaining points. Where the strength for one of the water-cement ratios is out of line and disregarded in plotting the curve it is satisfactory to commence paving operations with the under-

Fig. 16.—Shoveling Concrete Into Place in Front of Finishing Machine. Note Water Supply Tank and Water Haul Truck in Background

Fig. 17.—This Shows a Form Box for Two Concrete Beams for the Flexural Strength Test. Only the Beam on the Right Has Been Rodded. Note workability o the Concrete in the Section That Has Been Rodded

standing that check mixes of the same water-cement ratio are to be run the first day of paving operation. If time permits, arrangements are usually made to run the check tests prior to starting paving operation. In the event the water-cement ratio of 6 gal. per sack does not produce concrete with a flexural strength as great as that required by the specifications the curve is extrapolated to a lower water-cement ratio, but not below 5 gal. of water per sack without additional tests.

The coarse aggregate factor is not critical in the Water-Cement Ratio Tests and the value suggested for use above is chosen because it is the average of the values most commonly used. If the contractor desires that tests be made using a different value for the coarse aggregate factor, it is done as parallel tests to the prescribed Mix Design Tests. No material variation will be observed in the results of the flexural strength tests by virtue of a change in the coarse aggregate factor so long as the change is not radical.

Calculation of Mixture Design.—To start paving operations, proportions of materials to use for setting the batches are taken from the tests. The design is based upon a one-sack batch of concrete with the following determined (or known) design factors and aggregate characteristics which are examples to illustrate the procedure and were not taken from the records of the project north of Round Rock:

Design Factors—

Water-cement ratio	= 8.0
Coarse aggregate factor	= 0.80
Sand factor	= 0.88

Aggregate Characteristics—

	Aggregate Characteristics			% Absorption	% Free Moisture
	% Solids	% Voids	Sp. Gr.		
Cement	48.5	51.5	3.10		
Coarse aggregate	62.4	37.6	2.66	0.4	
Fine aggregate	63.9	36.1	2.64		3.5

The aggregates may have a certain amount of free moisture or they may have absorption. The percentages are determined and the figures inserted in the table above. The next step is the calculation of the proportions or weights of each ingredient for a one-sack batch.

1. *Determine absolute volume of cement paste.*

One sack of cement weighs 94 lb.

$$\text{Absolute volume of cement per sack.} = \frac{94}{62.5 \times 3.15} = 0.485 \text{ cu. ft. per sack.}$$

One cu. ft. of water contains 7.5 gal.

Water-cement ratio is 8.0 gal. per sack.

$$\text{Absolute volume of water} = \frac{8.0}{7.5} = 1.067 \text{ cu. ft. per sack.}$$

Absolute volume of cement paste = cement and water = 0.485 + 1.067 = 1.552 cu. ft. per sack.

2. *Determine absolute volume of mortar.*

Two steps are necessary. First, the absolute volume of paste for one cubic foot of mortar is determined. Since the sand factor is 0.88, each cubic foot of mortar will contain 0.88 cu. ft. of fine aggregate, saturated, surface-dry and loose. Beginning with the 0.88 cu. ft. of fine aggregate and filling its voids with cement paste, the amount of paste will be 0.88 × 0.361 = .3177 cu. ft. (absolute volume). The remainder of the cubic foot of mortar is paste, or 1.00 — 0.88 = 0.12 cu. ft. The total absolute volume of cement paste per cubic foot of mortar = 0.3177 + 0.12 = 0.4377 cu. ft. the remainder of the cubic foot of mortar being sand.

Next, the absolute volume of mortar which will be produced by one sack of cement is determined. Since one sack of cement will produce 1.552 cu. ft. of cement paste and since 0.4377 cu. ft. of cement paste will produce one cubic foot of mortar, 1.552 cu. ft. will produce $\frac{1.552}{0.4377}$ = 3.546 cu .ft. of mortar (absolute volume.)

3. *Determine absolute volume of fine aggregates.*

Fine aggregate equals total mortar minus cement paste equals 3.546 — 1.552 = 1.994 cu. ft. (absolute volume).

4. *Determine absolute volume of concrete.*

Two steps are necessary. First, the absolute volume of mortar per cubic foot of concrete is determined. Since the coarse aggregate factor is 0.80, each cubic foot of concrete will contain 0.80 cu. ft. of coarse aggregate, saturated, surface-dry, and loose. Beginning with this 0.80 cu. ft. of coarse aggregate and filling the voids with mortar, the amount of mortar will be 0.80 times 0.376 equals 0.3008 cu. ft. (absolute volume). The remainder of the cubic foot of concrete is mortar, or 1.00 — 0.80 equals 0.20 cu. ft. The total absolute volume of mortar per cubic foot of concrete equals 0.3008 plus 0.20 equals 0.5008 cu. ft., the remainder of the cubic foot of concrete being coarse aggregate.

Next, the absolute volume of concrete which will be produced by one sack of cement is determined. Since one sack of cement will produce 3.546 cu. ft. of mortar and since 0.5008 cu. ft. of mortar will produce one cubic foot of concrete, 3.546 cu. ft. will produce $\frac{3.546}{0.5008}$ = 7.081 cu. ft. of concrete per sack of cement (absolute volume).

5. *Determine absolute volume of coarse aggregate.*

The absolute volume of concrete minus absolute volume of mortar equals absolute volume of coarse aggregate equals 7.081 — 3.546 equals 3.535 cu. ft. per sack of cement.

6. *Check Total concrete.*

Total concrete equals cement plus water plus fine aggregate plus coarse aggregate equals 0.485 + 1.067 + 1.994 + 3.535 = 7.081 cu. ft. per sack of cement (absolute volume) equals yield.

7. *Determine cement factor.*

Since one cubic yard equals 27 cu. ft. and since one sack of cement will produce 7.081 cu. ft. of concrete, cement factor equals $\frac{27}{7.081}$ equals 3.813 sacks of cement per cu. yd. of concrete.

Summarizing, absolute volumes in cubic feet for one sack batch:

Fig. 18.—Two and One-Fourth Inch Slump Determined at Same Time Beams Were Made. Specifications Limit Coarse Aggregate Factor to a Maximum of 0.85

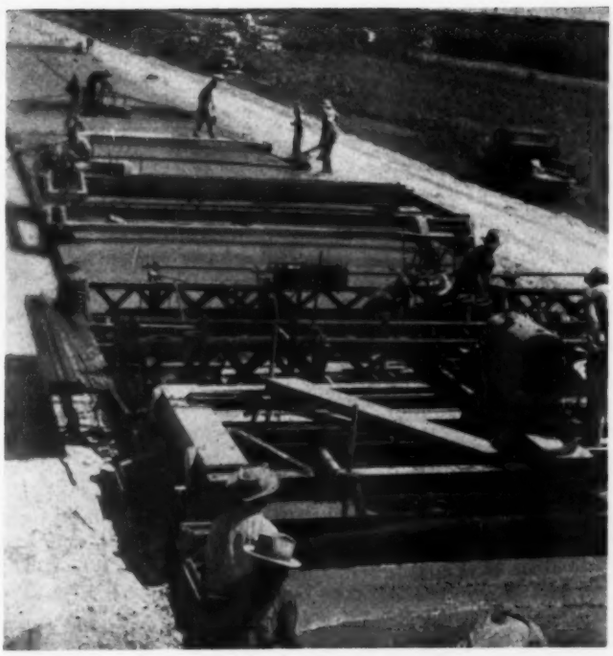


Fig. 19.—Finishing Machine, Flexplane Joint Machine, Longitudinal Finisher, Hand Finisher, and Center Stripe Machine Compactly Organized

Cement	0.485
Fine aggregate	1.994
Coarse aggregate	3.535
Water	1.067
Total yield	7.081

These absolute volumes are converted to weight in pounds, after which these weights are corrected for moisture content to give bin weights for a one-sack batch, and the designed amount of mixing water is compensated accordingly. For converting to saturated, surface-dry weights, the respective specific gravities are employed as follows:

	Cu. Ft. (Abs. Vol.)	×	Lb. of Water Per Cu. Ft.	×	Sp. Gr.	=	Lb.
Cement	0.485		62.5		3.10		94.0
Water	1.067		62.5		1.00		66.7
Fine aggregate	1.994		62.5		2.64		329.0
Coarse aggregate	3.535		62.5		2.66		587.7

The saturated, surface-dry weights of the fine and coarse aggregate are now corrected for free moisture and absorption, respectively, and the designed amount of mixing water is compensated accordingly.

The fine aggregate contains 3.5 percent and the coarse aggregate 0.4 percent free-moisture.

	Sat. Surf. Dry Wt. (lb.)		Corr. for Free Moist. $\left(1-\frac{\%\text{ F.M.}}{100}\right)$		Corr. for Absorption $\left(1+\frac{\%\text{ A.}}{100}\right)$		Batch Weights (lb.)
Fine aggregate	329.0	÷	0.965			=	340.9
Coarse aggregate	587.7	÷			1.004	=	585.4

Water in excess of the designed amount is being introduced into the mix with the aggregates in the form of free moisture:

Free water in fine aggregates equals

(check) $340.7 \times .035 = 11.9$ lb.

$340.9 - 329.0 = 11.9$ lb.

Absorption in coarse aggregate equals

(check) $585.4 \times .004 = 2.3$ lb.

$587.7 - 585.4 = 2.3$ lb.

Total free moisture in aggregates $= 11.9 - 2.3 = 9.6$ lbs.

Weight of water to be added at the mixer $= 66.7 - 9.6 = 57.1$ lb.

Gal. of water to be added at the mixer $\frac{57.1}{8.33} = 6.9$ gal.

Batch weights and water to be added at the mixer for a one-sack batch (corrections made for moisture) may be summarized as follows:

Cement	94.0 lb.
Fine aggregate	340.9 lb.
Coarse aggregate	585.4 lb.
Water	6.9 gal.

This batch will yield 7.081 cu. ft. of concrete.

It is apparent from the foregoing design that the cement factor is a function of the voids in the coarse and fine aggregates, the cement factor increasing as the voids increase. It is also apparent that the cement-factor is a function of both the sand factor and the coarse aggregate factor, the cement factor decreasing as either or both of these factors increase. It is therefore imperative to keep both the sand factor and the coarse aggregate factor as high as possible, consistent with proper workability, to realize greatest economy.

Bulk Cement Method Advisable

It is apparent that the bulk cement method of proportioning is advisable. In fact, strength design places a premium on the bulk cement method of batching over the bag method.

For example, let us refer to our illustrative problem again. From the design of the concrete mix we found that the cement factor of the batch was 3.813 sacks per cu. yd. Since paver capacities are expressed in cubic feet 3.813 sacks per cu. yd. must be converted to cubic feet of concrete per sack of cement by dividing 27 by 3.813. This gives 7.081 cu. ft. of concrete per sack of cement.

The Texas specification permits a 20 per cent overload on pavers. Hence for a 27 E paver this would be 20 per cent of 27 cu. ft. or 5.4 cu. ft. Added to the 27 cu. ft. gives the allowable batch as 32.4 cu. ft. of concrete per batch.

To find the number of sacks of cement for this allowable batch, divide 32.4 cu. ft. by 7.081 cu. ft. per sack of cement and obtain 4.58 sacks of cement required.

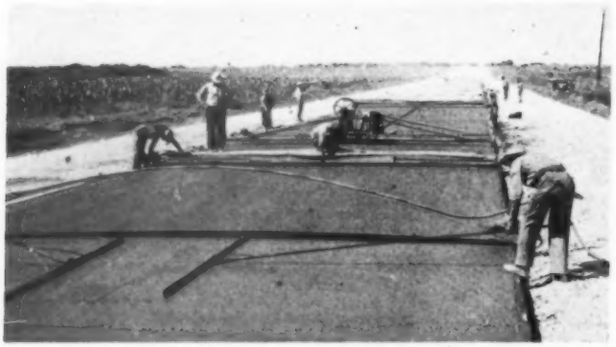


Fig. 20—Hand Finishing of Surface Joints and Edges. Note Center Stripe Machine in Background

Fig. 21.—Permanent Center Stripe Being Installed

Assuming the contractor used bag cement, the state would not allow 5 sacks to be used even though extra cement would go into the batch. To use 5 sacks the mix would be redesigned so as not to exceed the 32.4 cu. ft. volume. A smaller water-cement ratio would result and therefore the contractor would be paying a penalty in cost of concrete. He would not do this. Therefore, if sack cement were used, only, a 4 bag batch would be employed. In such a case, the contractor's batch would be 4 times 7.081 cu. ft. or 28.3 cu. ft. Hence he would be losing 32.4 cu. ft. minus 28.3 cu. ft. or 4.1 cu. ft. of concrete each batch, which could be mixed free if bulk cement were used.

At the rate of 400 batches per day this would amount to 400 times 4.1 or 1640 cu. ft., which is approximately 61 cu. yds. per day. Had the contractor, in this example, employed the bulk cement proportioning instead of the bag cement method, he could have poured 366 sq. yds. more of 6 in. pavement at no extra mixing cost and, practically speaking, with no extra time.

It is evident, therefore, that the bulk cement batching method is advisable.

Job Control

Paving operations were started using the water-cement ratio that the flexural strength curve indicated would produce the specified 600 lb. per sq. in. flexural strength, and the proper mix proportions to produce workable concrete with a 2 in. slump. This water-cement ratio was not changed until sufficient flexural strength tests were made to indicate that the strengths being obtained were not within the limits allowed by the specifications. The coarse aggregate factor and sand factor were varied as necessary to maintain the required workability.

The specification requires that two flexural strength tests be made from the concrete for each 500 square yards of pavement or less as ordered by the Engineer. It is intended that these two tests be made on two 6 in. by 6 in. by 20 in. beams made from the same batch of concrete, and that the average modulus of rupture of these two beams be recorded as one flexural strength value representing that area of pavement. The specification further stipulates that changes in the water-cement ratio are to be made by referring to the average 7-day flexural strength of the concrete as shown by the last ten flexural strength values. (Each the average of two beam tests.) This is not interpreted to mean separate groups of ten flexural strength values and the proper use of this provision is illustrated by the following example:

The following 32 beams were made from the same water-cement ratio and the 16 flexural strength values are the average of each two tests. The beam tester is a regular beam type, not cantilever type.

Date Made	Beam Number	Date Tested	Flexural Strengths
5-2-41	1 & 1	5-9-41	610
5-2-41	2 & 2	5-9-41	615
5-2-41	3 & 3	5-9-41	674
5-2-41	4 & 4	5-9-41	592
5-2-41	5 & 5	5-9-41	605
5-2-41	6 & 6	5-9-41	585
5-2-41	7 & 7	5-9-41	614
5-3-41	8 & 8	5-10-41	588
5-3-41	9 & 9	5-10-41	597
5-3-41	10 & 10	5-10-41	608
5-3-41	11 & 11	5-10-41	603
			Ave. 608
5-5-41	12 & 12	5-12-41	615
5-5-41	13 & 13	5-12-41	579
5-5-41	14 & 14	5-12-41	593
5-5-41	15 & 15	5-12-41	493
5-5-41	16 & 16	5-12-41	607
			Ave. 590— Adj. Ave. 600

After testing the four beams on 5-10-41, an average was made of the flexural strengths of beams 2 to 11, inclusive, which is in this case 608 lb. per sq. in. To determine that all the beams used in calculating the average were normal, it was necessary to establish the maximum and minimum flexural strengths which are to be considered as representative. The maximum value is (100 + 15)% of 608 — 699 lb. per sq. in. The minimum value is (100 — 15)% of 608 = 517 lb. per sq. in. Since all the results of beams 2 to 11 inclusive were within the range of 699 and 517 lb. per sq. in., the average of 608 lb. per sq. in. was used to determine whether or not a change was necessary in the water-cement ratio.

When the five beams were broken on 5-12-41, it was again necessary to strike an average of the last ten results of flexural strength tests. This average was taken of beams 7 to 16, inclusive, and equals 590 lb. per sq. in. When checking for normal beams as described above, it was found that test results for beam 15 were outside the limits. Hence, it was necessary to re-average the test results of beams 7 to 16, inclusive, omitting the test result of beam 15. This establishes an adjusted average of 600 lb. per sq. in. which was used to de-

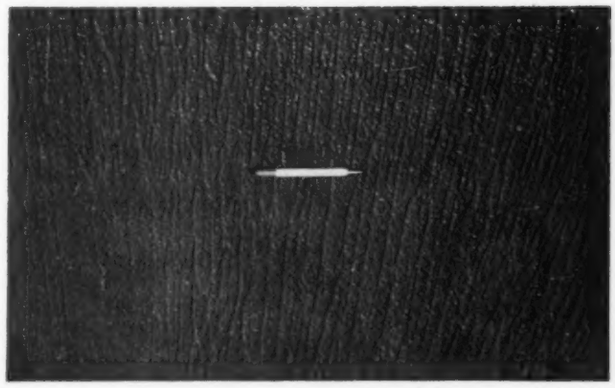


Fig. 22.—Surface Texture Immediately After Finishing. Note Scarcity of Surface Water

termine the necessity for a change in the water-cement ratio.

The plant inspector makes all changes in mix design and changes the batch weights at the plant. This change is conveyed to the mixer operator by a truck driver in the form of a note attached to a red flag. One of the pictures, herewith, shows the truck with the red flag. The notes on the red flag are for the mixer inspector and mixer operator to change the amount of mixing water. This is done not only after changes in design but when moisture tests (made every 30 minutes) indicate a change in water is necessary. (In some instances, where the maximum water-cement ratio produces concrete with a flexural strength greater than that specified, change will be impossible.) This new water-cement ratio is determined by plotting the average flexural strength of job tests against the water-cement ratio, and drawing a new curve through this point and parallel to the original flexural strength curve.

If bleeding occurs or the concrete fails to meet any of the requirements for workability, the engineer will attempt to correct this condition by changing the mix design, or by requiring the use of mineral filler (stone dust, etc.). In case it is necessary to change aggregates or to use an additional aggregate, preliminary strength tests will be required.

Explanation of the Use of Flexural Strength Curves.—To illustrate the use of the flexural strength curves when starting paving operations and its use as a guide during construction the following example is given:

In this example the minimum average flexural strength of 600 lb. per sq. in. at 7 days is specified. From the flexural curve, figure 2, it is seen that an average strength of 600 lb. per sq. in. may be obtained with a water-cement ratio of 8.1 gal. per sack. Since a maximum water-cement ratio of 8.0 gal. per sack is specified and the minimum average flexural strength is obtained using 8.1 gal. of water per sack, in this example the proper water-cement ratio to use is 8.0 gal. After paving started the average of the last ten flexural strength values obtained with this water-cement ratio was 567 lb. per sq. in. Since this average is not within the specified limits, the mix was redesigned using a new-watercement ratio. To obtain the new water-cement ratio, the average flexural strength values were plotted upon the vertical line representing the water-cement ratio used, in this case 567 lb. per sq. in. and 8.0 gal. Through this point a curve was drawn geometrically parallel to the original flexural strength curve, and the new water-cement ratio determined by the intersection of this curve and the horizontal line representing the required flexural strength. In this example it is found that 7.6 gal. will produce the required flexural strength.

Having determined the corrected water-cement ratio necessary to produce the specified flexural strength, a new mix is designed. In designing the new mix the sand factor is determined by the use of figure 1. In this example a batch design would be calculated based upon a water-cement ratio of 7.6 gal. per sack, a sand factor of 0.87, and retaining the coarse aggregate factor previously used.

Credits

This article was prepared from interviews and information furnished to the writer by the Texas Highway Department of which Mr. D. C. Greer is Chief Engineer. The manuscript was checked by Mr. R. J. Hank, Materials and Tests Engineer, before it was published. Mr. E. B. Cape who preceded Mr. Hank in the department furnished the pictures and read much of the manuscript during its preparation. Mr. A. C. Love and Mr. Walter Youngs, Jr., of the Texas Highway Department gave the writer complete cooperation on this article.

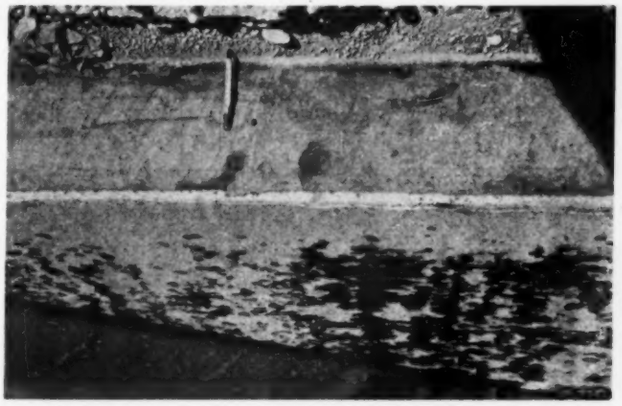


Fig. 24.—Edge and Surface of Pavement. Note Surface Water Under Curing Paper and the Absence of Honeycomb on Edge Pavement

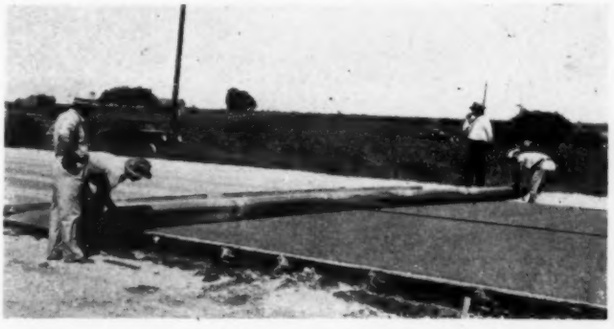


Fig. 23.—Sisalkraft Curing Paper Being Placed After Set of Concrete

FIVE STATES ENACT TOLL SUPER-HIGHWAY LEGISLATION

Following much the same pattern as that for the Pennsylvania Turnpike, five states, Florida, Illinois, Maine, Maryland and New York this year enacted legislation authorizing toll super-highways. These laws follow a general pattern of creating an independent authority (except in the State of Maryland where the State Roads Commission is designated) with broad powers, including eminent domain, for the construction and operation of turnpikes to be financed through tolls.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ Centerlining more than 8,000 miles of paved roads each year is a Herculean task but the Ohio Department of Highway is doing the job at the rate of about 150 miles a day.

Compare that figure with the total of about 45 miles a day of centerlining carried out laboriously by manual labor not more than two years ago, and it is readily seen that the use of painted stripes on the pavement as a safety factor has moved ahead in giant strides.

• •

¶ A.P.J. sticks tight to his title. This view on U. S. 66 is only one of 7 puddles jumped that day in Illinois.

• •

¶ Steel shop name sign of a dragline bucket manufacturer at Baton Rouge, La.

¶ Making a soil-cement stabilization job near Woodward, Oklahoma. All pulverizing, aerating, and mixing, both dry and wet, was done with this single 5-ft. Pulvimixer machine.

• •

¶ For levelling up rough pavements and patching broken surfaces a cold-mix asphaltic concrete is used

in District 6 [Pecos], Texas. The mixture is crushed stone, limestone rock asphalt dust (screenings) and road oil (RO-3). Man shovels rock asphalt dust into beater in order to break down any of the rock dust which has stuck together. One picture shows the beater in action, the other picture shows the chains on the inside. They were made in the district shop.

• •

¶ Two or three miles east of Boonesboro, Maryland, on U.S. 40 between Frederick and Hagerstown

on the top of a mountain to the north of the highway stands this monument. The sign shown here is at the junction of a trail which leads up to the monument from U. S. 40. Car shown in background is speeding eastward upgrade on U. S. 40.

This monument overlooks the peaceful valley in which Boonesboro is located. It is built of native stone. Some difference between this monument and the one at Washington, D. C.

• •

¶ Maintenance forces get all kinds of dirty jobs. This dead cow on U. S. 71, struck by a motorist, was one of four along the road between Baton

Rouge, La., and Bunkie, La. This one is just north of where U. S. 71 branches off the main east and west road.

• •

¶ Painting highway bridges without interference with automobile and truck traffic no longer is a problem in Wapello County, Iowa. Bridge painters employed on WPA projects in the county devised an inexpensive scaffolding system on which they may work in safety.

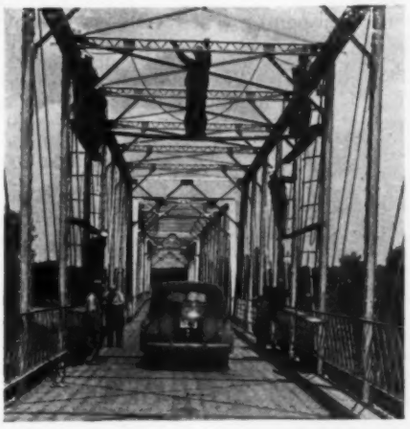
The painter's rig, which uses Jacobs ladder to support the scaffolding planks, is so simply con-

structed that it is possible to set it up and have 14 men working on it in half an hour or less. It was designed and built by a WPA foreman who served 14 years in the U. S. Navy.

Specially designed steel hooks, which are adjustable to fit any size bridge girder, were added to the usual seaman's ladder which has two ropes knotted at regular intervals to hold the cross-steps in place. When the hooks are locked across the top of the bridge structure, the ladders hang about 18 inches from the side of the bridge, leaving plenty of space through which cars and trucks may pass.

The rungs of the ladder are curved slightly upward and strengthened by a cable that runs underneath. The cables have turnbuckles for use in taking up any slack that may occur and maintaining the upward curve of the step.

The planks used in the scaffolding are of spruce, two inches thick and 12 inches wide. They, too, are reinforced by steel cables with turn-



buckles and are tied to the bridge girders when in use. Two or three planks may be used at one time in painting the structure if the bridge is of sufficient height. And at the same time other planks may be laid from one side of the bridge to the other and parallel to the horizontal bridge members, enabling the workers to paint an entire section of the bridge before moving the scaffold.

To insure the safety of the workers, every piece of the rig is reinforced and braced. It has been used successfully on several projects in Wapello County.

• •

¶ Army column in Sanderson, Texas, on maneuvers. These convoys quickly clog a road making ordinary travel next to impossible.

¶ Ravages of erosion shown by suspended fence. This view was taken on Louisiana Rt. 20 about 1 mi. southeast of Zimmerman. Uncontrolled erosion takes a heavy toll of roadside backslopes.

• •

¶ Talking about blueprints — the Allegheny County Housing Authority (Penn.) during the month of June had 5 tons of blueprints pour into its office from all commercial blue printing outfits in the county— 5 tons!

• •

¶ Editor

"Dear Friend:

"This chain was started in Reno in the hope of bringing happiness to all tired businessmen. Unlike most chains, this does not cost any money. Simply send a copy of this letter to five male friends, then bundle up your wife and send her to the fellow whose name heads the list. When your name works up to the top, you will, in turn, receive 15,176 gorgeous girls.

"HAVE FAITH
"DON'T BREAK THE CHAIN

"One man broke the chain and got his wife back!"

• •

¶ Hand mitt-tool used by dropper in placing vitrified block pavements.

HOT TAR CONCRETE

An Old Type Revived and Modernized to Meet Present Day Traffic Conditions

By GEORGE E. MARTIN
Consulting Engineer
General Tarvia Department
The Barrett Co., New York

ONE of the early uses of tar for road purposes was in the manufacture of hot tar concrete. Many pavements were built of this material and some of them are still carrying traffic although more than a quarter of a century old. Most of the early New England tar sidewalks, many of which are still in use, were a mixture of gravel or stone and hot tar binder.

The rapid developments in the use of tar for penetration macadam, surface treatments and road mixes diverted attention from the hot tar concrete. The type was neglected and practically no pavements of the kind were laid for several years.

Ohio Practice

A few years ago the use of the type was started again in Ohio and several successful projects have been built. In the first work in Ohio the hot tar concrete was used as a foundation and covered with a cold mix. In the later jobs in Ohio the hot tar concrete has been used for the leveling course and also for the surface course.

Typical Hot Tar Mix Plant

In the design of the mix for the hot tar concrete in Ohio a better filled mix is provided than for the cold tar concretes. A typical aggregate grading is as follows; the figures are the percent passing square opening sieves:

	Binder Course	Top Course
Passing 1½ inch sieve	100	.....
Passing 1 inch sieve	70-100	.....
Passing ½ inch sieve	20-60	100
Passing ⅜ inch sieve	.....	85-100
Passing No. 4 sieve	5-20	55-80
Passing No. 8 sieve	0-5	35-65
Passing No. 40 sieve	.....	14-34
Passing No. 100 sieve	.....	6-20
Passing No. 200 sieve	.....	5-15

On any specific job a mix is set up within these gradings and the contractor is permitted to deviate only certain specific amounts from the job formula. For the ½ in. and larger sieve requirements, the deviation permitted is plus or minus 10 percent with plus or minus 5 percent for the ⅜ in. to No. 100 sieve requirements and plus or minus 2 percent for the material passing the No. 200 sieve.

The amount of tar required in the binder course varies from 3 to 5 percent for stone and from 4 to 6 percent for slag. For the top course the percentages of tar in the mix are from 6.5 to 8.5 for stone and 7.5 to 10 for slag. A variation of plus or minus ½ percent from the percent of tar set in the job formula is permitted.

The tar used is a heavy tar binder. In most cases it will be a tar meeting the A. A. S. H. O. specifications for tar Grade RT-11 or RT-12.

In the very early work the tar was often heated in open kettles and mixed with the aggregate by hand or in a crude mixer. Modern specifications require careful control of the aggregates and a properly equipped mixing plant.

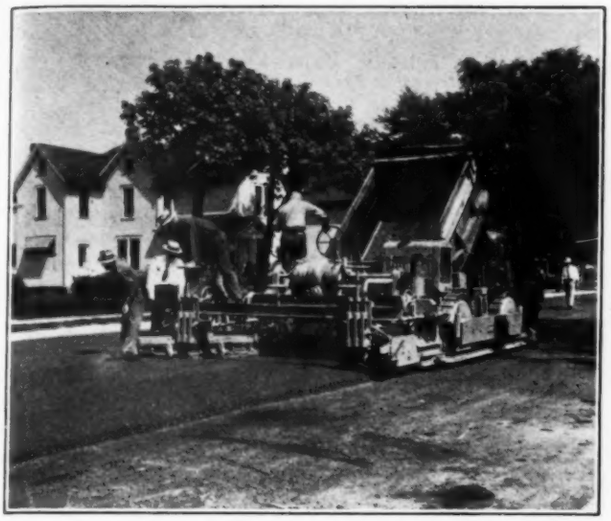
The Mixing Plant

Separate bins must be provided for each size of aggregate and the coarse and fine aggregates must be separately fed by proportional feeders to the cold elevator or elevators in their proper proportions and at a rate to permit correct and unifom temperature control of the heating and drying operation. The feeders must be capable of feeding at least three separate aggregates in their proper proportional ratio.

The plant is required to have a drier of such type that the aggregates will be continuously agitated during the heating and drying process, and the drier must be designed so that temperatures can be positively regulated.

The proportioning of the different ingredients of the mix is usually by weight.

A typical requirement for the mixer is that it shall be of the twin pug mill batch type, steam jacketed and of not less than one ton rated capacity. Time locks to control the mixing cycle by locking the tar bucket through-



Spreading Hot Tar Mix

Rolling Hot Tar Mix

out the dry mixing period and by locking the mixer gate throughout the dry and wet mixing periods are required.

The aggregate is heated to not less than 150° F. nor more than 225° F. when admitted to the mixer. The tar to be added to the aggregate is heated to between 175° F. and 250° F.

The aggregates are mixed dry for a period of 15 seconds after which the tar is added in an evenly spread sheet the full length of the mixing box. The mixing is then continued for at least 30 seconds. The total time of mixing is the interval of time between the opening of the weigh box gate and the opening of the mixer gate. This total time must be not less than 45 seconds.

Hauling, Spreading and Finishing

Trucks used to transport the mixture must be clean and tight. Generally a waterproof canvas cover is used to protect the load during transit. No loads may be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight unless satisfactory artificial light is provided on the job. The mixture is delivered to the work within 20 degrees of a temperature specified between 150° F. and 225° F.

The hot tar concrete may be used as a surfacing material over a new foundation or over an existing road. It may be spread in two layers using a binder course and a top course or may be used to construct the surface course only. Traffic and other local conditions will determine the way in which the material is used.

In most cases the hot tar concrete will be spread and finished by mechanical spreading and finishing equipment. This equipment may ride upon side forms or may employ mechanical devices such as equalizing runners, evener arms or other compensating devices to adjust the grade and confine the mixtures to true lines without the use of side forms. The paver when laying mixtures operates at a speed of not less than 10 feet per minute and not more than 35 feet per minute.

Compacting the Mixture

For compacting, rollers weighing from 7 to 10 tons are usually specified. Tandem rollers are commonly used. Rolling is done as soon as the mixture has cooled sufficiently so that the roller does not cause undue displacement or shoving. One roller is required for each 250 tons of material placed and finished per eight hour day.

The roller wheels are kept moist to prevent the adhesion of the tar binder to the roller. Successive trips

Hot Tar Mix Top Course on Left. Leveling Course on Right

Finished Street

of the roller are required to lap uniformly by at least one-third the width of the roller.

The finished wearing course is not permitted to vary more than ½ inch from a templet cut to the cross-section or more than ⅜ inch from a ten foot straight edge applied parallel to the center line of the pavement.

Traffic may be permitted to use the pavement as soon as it has cooled but in no case in less than two hours after the finished rolling.

The hot tar concrete has been proven to be a tough durable, non-skid pavement. Experience has shown that the surface should go without maintenance for several years. It is flexible and easy to handle under normal conditions.

This revived type can be successfully used for new work as well as the re-surfacing of existing pavements. It is equally satisfactory for the pavement of runway surfaces as well as other incidental paving around airports.

FOURTH PAN-AMERICAN HIGHWAY CONGRESS

Concluding a most successful meeting the Fourth Pan-American Highway Congress adjourned at Mexico City, Mexico, on Sept. 24, 1941.

The Congress was divided into four committees:

1. Highway Engineering
2. Finance and Administration
3. Operation and Safety
4. International Affairs

Out of about 121 papers submitted to the Congress for consideration, 78 were handled by the engineering committee. Following is a table of organization of the highway congress:

DIRECTORS AND COMMITTEES

President—Ing. Vicente Cortés Herrera (México)
Secretaria de Communicaciones y Obras Públicas

Vice Presidents—The chairmen of the official delegations of the various countries.

General Secretary—Ing. Armando Santacruz, Jr. (México) Subsecretario de Comunicaciones y Obras Públicas

Technical Assistant Secretary—Sr. Arturo Zuñiga Latoore (Chile) Subsecretario de Fomento

Technical Assistant Secretary—Ing. Frederico Capurro (Uruguay) (Official Delegate)

Technical Assistant Secretary—Ing. León Cuéllar (El Salvador) (Official Delegate)

Technical Assistant Secretary—Mr. J. S. Williamson (United States) Director of Highway, South Carolina

I—HIGHWAY ENGINEERING COMMITTEE

Chairman—Mr. E. W. James (United States)
Chief, Division of Highway Transport, U. S. Public Roads Administration

Vice Chairman—Ing. Oscar D. Tenhamm (Chile)
Director General de Caminos

Secretary—Dr. Teunis Stalk (Venezuela)
Sub-Jefe de Depto. de Viás del Ministerio de Comunicaciones y Obras Públicas

Reporter—Ing. José Moriano Pontón (México)
Dirección Nal. de Caminos

Reporter—Ing. Alberto Dovali Jaime (México)
Dirección Nal. de Caminos

Reporter—Ing. Mauricio Urdaneta (México)
Dirección Nal. de Caminos

II—FINANCIAL AND ADMINISTRATIVE COMMITTEE

Chairman—Lic. Rodolfo Soriano (Bolivia)
(Chairman of Bolivian Delegation)

Vice Chairman—Ing. Juvenal Monge (Peru)
Dip. al Congress Nal. del Depto. de Cuzco

Secretary—Ing. Ernesto Jaén Guardia (Panamá)
Ministro de Panamá en México

Reporter—Sr. José Carlos Ornelos (México)
Dirección Nal. de Caminos

III—COMMITTEE ON HIGHWAY OPERATION AND SAFETY

Chairman—Sr. Antonio Flores Vega (Nicaragua)
Ministro de Fomento y Obras Públicas

Vice Chairman—Dr. Emilio Fajardo (Colombia)
Exsecretario de Obras Públicas del Depto. de Valle

Secretary—Ing. Rafael Garcia Bango (Cuba)
Secretaría de Obras Públicas

Reporter—Ing. Francisco Rodriguez Cabo (México)
Dirección Nal. de Caminos

IV—COMMITTEE ON INTERNATIONAL AFFAIRS

Chairman—Ing. Emilio López Frugoni (Argentina)
Presidente de la Dirección Nacional de Vialidad

Vice Chairman—Mr. J. Van Ness Phillip (United States) Financial Commissioner of the Pan-American Highway

Secretary—Arq. Luis Felipe Donoso Barba (Ecuador)
(Official Delegate)

Reporter—Lic. Sergio Cuéllar (México)
Secretaría de Comunicaciones y Obras Públicas

In all, 39 resolutions were passed at the plenary sessions.

The meeting provided an excellent place for understanding regarding the completion of the Pan-American highway, completion of which, at an early date, was recommended.

Technical papers presented for publication were assigned to reviewers who recommended to the highway engineering committee what disposition should be made of them.

The equipment exhibit which was held at the National Stadium was well organized and a healthy show was quite representative of road building equipment. The show was under the supervision of Sr. José Rivera R., Secretary of the Mexican Automobile Association. Delegates and associate delegates were very busy, not only at the meetings but also in visiting interesting places of Old México.

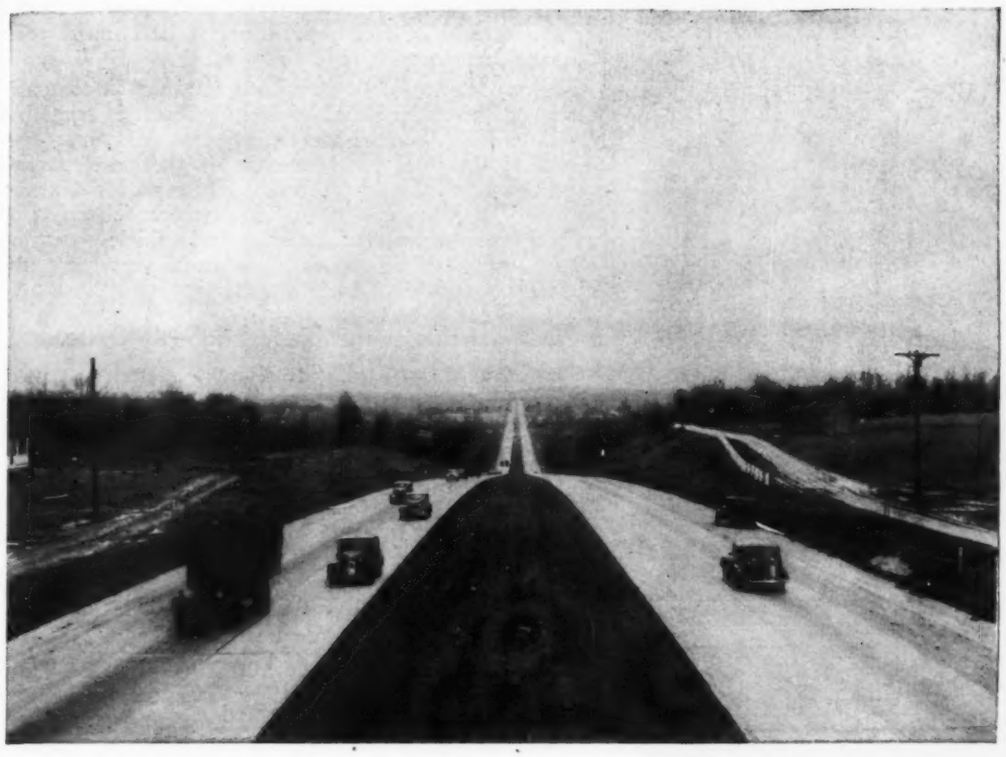
MADISON, WISCONSIN, AIRPORT IMPROVEMENT

One of the many items of the national defense programs is the lengthening and widening of runways at the Madison, Wisconsin, Municipal Airport. The photo-

Bituminous Construction at the Madison Airport

graph shows surfacing operations in progress late last summer. The surface is a 2-in. bituminous mat 150 ft. wide over a crushed limestone base. Speedy construction was an important factor in the selection of this type. The project totals 10,000 tons of bituminous mix, about half of which was complete when the photo was made.

Payne & Dolan of Wisconsin are the contractors. The machine in the picture is a Barber-Greene tamping-leveling finisher. The airplane, piloted by one of the 120 aviation students now enrolled at Madison, has just taken off from the old stretch of runway in the background.



Highway Improvement, As Shown By This View Along the New Philadelphia Road, Eliminates Steep Grades with a Resultant Safe and Free Movement of Traffic

REPORT ADVISES MARYLAND MODERNIZE ROADS OF STATE

Detailed Study Presents Plan Which Will Accomplish Desired Results

SALIENT facts about the condition of Maryland's highways today, the problems involved in modernizing the highways, and the proposed solution of these problems (presented here), are the results of studies of the many phases of highway transportation and financing conducted by the State-wide Highway Planning Survey of the State Roads Commission of Maryland in cooperation with the Public Roads Administration of the Federal Works Agency. The report, "Maryland Highway Needs," and supplementary publications of the Highway Planning Survey provide a more detailed analysis of the facts and recommendations condensed in this article.

Highways are a long-term investment and sound planning can best be accomplished through the widespread interest and support of all those who pay for and use the roads.

The Highway Systems

As of January 1, 1938, there were 18,127.6 miles of roads and streets in Maryland. The State Roads Commission has direct control over the State highway system, comprised of 4,056.6 miles of the most heavily traveled routes, of which 3,900 miles are in rural areas. The county roads, 10,935.8 miles, are the joint responsibility of the State Roads Commission and the county commissioners of the respective counties. Municipal roads and streets, comprising 1,811.7 miles, are controlled by the various incorporated towns, approximately 1,000 miles being in Baltimore City. Federal reservation and State Institution roads, and roads disclaimed by all public agencies constitute the remaining mileage.

Narrow Roads and Deteriorated Surfaces

A View of One of the 1,500 Places on the Rural State Highway System Where Step Grades and Two-Lane Pavements Retard Traffic and Produce Hazards

Inadequate Structures Abound

With an average of 0.4 miles of rural state highway per square mile of land area, Maryland has more road coverage than forty-four other states.

The importance of the rural state system in comparison to other rural roads is evident when it is seen that the 3,900 miles comprising this system, less than one-fourth of the total rural mileage of the state, carries 84 percent of the total rural travel. The need for modernization of this system of roads is urgent. The cost of highway maintenance to the state and vehicle operation to the motorists increases with each year that the modernization is delayed.

Deficiencies in the State Highway System

The inadequacy of the state highway system to accommodate even present-day traffic is evidenced by:

1. 6,000 sharp curves around which it is unsafe to drive at normal speed, an average of three such curves in each two miles of road;
2. 1,500 steep grades that delay the free movement of passenger vehicles because of slow-moving trucks;
3. 16,000 places where obstructions limit sight distance and produce traffic hazards;
4. More than 400 inadequate bridges;
5. Excessive mileage of low-type surfacing which requires heavy maintenance expenditure;
6. Many miles of deteriorated surfaces;
7. Inadequate trans-city connections;
8. Inadequate rights-of-way; and
9. Narrow pavements—77 per cent of this mileage is less than 20 feet. Present traffic requires surface width of 22 feet or 24 feet on all main highways.

These deficiencies are further emphasized by the constantly increasing traffic. It is estimated that the vehicle-miles of travel in 1960 will be double that of today, an average increase of 5 per cent each year.

On the rural state highway system, the cumulative length of curves over 6 degs. in non-mountainous areas and over 13 degs. in mountainous areas totals 399.42 miles or one-tenth of the total mileage. Also, on the average, there are four places on every mile of rural state highway system where restricted sight distances create hazardous conditions.

The cumulative length of excessive grades on the rural state highway system is 320.4 miles, or an excessive

Old Bridge Over the Susquehanna River at Havre de Grace (U. S. 40)

Inadequate Rights-of-Way Increase the Cost of Widening Heavily Traveled Roads. This Is a Section of the Baltimore-Washington Blvd.

grade approximately one mile long in every twelve miles of the state highway system.

These views of the old and new bridges over the Susquehanna River at Havre de Grace show how highway modernization has eliminated one of the more than 400 inadequate bridge structures on the rural State highway system.

Cost of Modernization

Each mile of the state highway system has been analyzed in detail, the present deficiencies are known, the cost of improving the various routes has been estimated, and the order of improvement has been established. These data are too voluminous for inclusion here, but are available in the offices of the State Roads Commission.

The cost of improving the state highway system (including trans-city connections) to desirable standards to accommodate present and future traffic, is estimated to be $216,947,500. Modernization should be accomplished over a period not to exceed 20 years, or by 1960. This amount includes improvements urgently needed within the next 5 years, estimated to cost $55,272,000.

Based on present sources and rates of revenue, including regular federal-aid and assuming no diversion of highway funds, the amount available for modernization purposes during the period 1941 to 1960 is estimated to be only $168,271,000 or approximately four-fifths of the required amount. During the 5 years from 1941 to 1945 it is estimated that only $34,635,000 or three-fifths of the amount urgently needed will be available.

Financing the Modernization Program

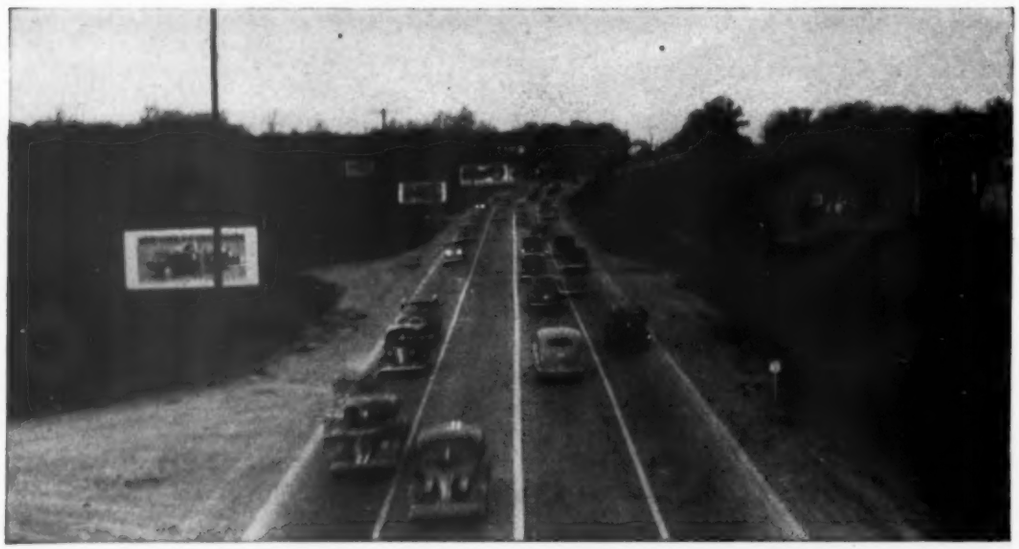
As indicated in a previous paragraph, the estimated revenues available for modernization during the next 20 years will be $48,676,500 less than the estimated cost. This deficiency is even more pronounced in the improvements immediately required—work which should be completed within the next 5 years. The estimated cost exceeds estimated revenue during this period by $20,637,000.

Unless present procedures are revised to produce more efficient and economical highway administration, and unless present revenues are increased, the highways will continue to become more and more obsolete and ultimate modernization will be forestalled and made more costly.

Congested Traffic Conditions

New Bridge Over the Susquehanna River at Havre de Grace (U. S. 40)

An increase of 1 cent per gallon in the motor fuel tax would probably furnish sufficient funds. However, *this is not recommended* since the existing 4-cent tax is approximately equal to the average for the nation as a whole (3.96 cents) and it is not believed equitable to tax Maryland motor vehicle owners approximately 25 per cent more than this national average. Likewise, there is now a considerable loss of motor fuel tax



A Crowded, Unattractive Section of the Baltimore-Washington Boulevard Which Averages 15,000 Vehicles Per Day

revenue occasioned by lower gasoline prices in neighboring areas, particularly in the District of Columbia; hence, higher taxes in Maryland would tend to increase this loss.

Passenger car registration fees in Maryland averaged $8.29 in 1938, approximately equal to the United States average of $9.25 and compared favorably to the average of $11.17 for those states in the immediate vicinity of Maryland. *No change is proposed in these fees.*

In contrast, trucks in this state are being subsidized by passenger car owners. The average registration fee for trucks in Maryland in 1938 was $11.20, less than $3.00 more than the average paid for passenger cars. The average fee paid for trucks in the surrounding states was $30.47. *It is recommended that registration fees for certain classes of trucks be increased.*

Equitable truck registration fees, based on the average annual ton-miles of travel, have been computed for trucks of various weight groups. These fees reflect the size and weight of trucks together with their average road usage. *It is recommended that legislation be adopted to make such fees effective.* If these fees are adopted, the average registration fee for trucks in Maryland will be approximately $27.00 and gross income will be increased approximately $1,000,000 annually.

There is paid out of the motor fuel tax receipts each year more than $800,000 in refund claims. These refunds for taxes paid on motor fuel for "non-highway use" represent approximately 7 per cent of the total motor fuel tax collected and are believed to be excessive. In 1929 the ratio of refunds to gross receipts was only 3.5. Since 1929 refunds have increased three times as fast as gross receipts. Thirty states refund a smaller proportion of their gross collections than does Maryland. *It is believed that a more rigid enforcement of refund legislation would save the highway users of Maryland not less than $350,000 per year.*

Highway Administration

In the interest of greater efficiency and economy, highway administration should be consolidated since more than 150 governmental agencies collect and spend money for roads and streets in Maryland. *It is proposed that the rural roads of the state be administered as follows:*

1. The most heavily traveled roads, comprising about 2,000 miles, should be established as the state primary system.
2. Feeder roads, about 8,000 miles, should be established as the state secondary system.
3. The State Roads Commission should be made fully responsible for these two systems and they should be financed exclusively from the motor fuel tax, registration fees, and federal-aid.
4. The remaining 6,000 miles of rural roads consist of local or land service roads and are not now important arteries of travel. They serve primarily the owners of adjoining property. These roads, since they are local in character, should be the responsibilities of the various counties and should not be financed from motor vehicle tax revenues.

A View Along the Governor Ritchie Highway from Baltimore to Indianapolis Showing the Elimination of These Deficiencies by Modernization

DEFENSE

Begins with

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FARMER HENDERSON picked his way through the heavy snow to his mail box. Swish—swish—a car, a milk truck, a huge transport rolled by—long streams of them—endless—hurrying over the roads. There were raw materials for manufacturing plants, food for the men of industries, experts hurrying to solve problems, finished goods to meet a nation's needs in a great emergency.

Snow must not reduce the speed and safety of delivery today—defense begins with open roads—Snogo-cleared roads!

Snogo-cleared roads are open roads, safe roads. Snogo-protected communities are normal communities. Workers get to their jobs, deliveries go through.

Snogo throws the snow off the road where it can do no harm. No banks build up into ever deepening, ever narrowing, dangerous one-way bottlenecks that delay traffic and endanger lives. Ditches are open and function normally, carrying off surface water that damages road surfaces and shoulders.

More than ever before every highway official owes the assurance of open winter roads to his community and the country.

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For Complete Snow Removal

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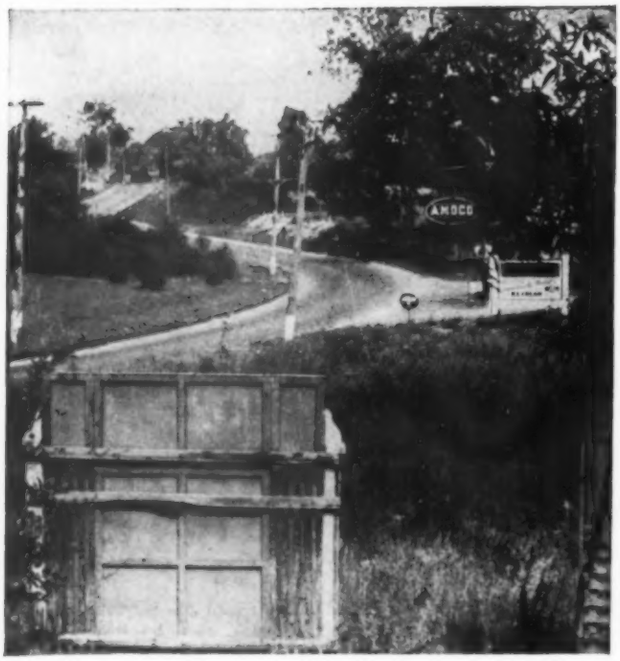

View Along the Old Baltimore-Annapolis Road Illustrating Deficiencies in the State Highway System Resulting from Poor Alignment

Highway funds are now allocated to the State Roads Commission, the counties, and to Baltimore City. *It is proposed that a "highway fund" be established,* comprised of receipts from the motor fuel tax, registration and miscellaneous fees, and federal-aid. This fund should be allocated to the various highway and street systems on the basis of relative needs of the several systems, road usage by motor vehicle owners, and contributions to highway funds by owners resident in various areas of the state. Based on these factors (as developed by this survey) the State Roads Commission should be allotted 58 per cent of the funds for primary rural roads, 4 per cent for urban state roads outside of Baltimore City, and 18 per cent for secondary rural roads. Baltimore City should be allotted 7 per cent for streets connecting state roads and 13 per cent for arterial streets, a total of 20 per cent—a greater percentage of state motor user funds than any other state allots to *all* its municipalities for highway purposes.

Expenditures from this proposed allocation of the state's funds to Baltimore City should be restricted to actual cost of maintaining and constructing a street system, composed of through routes connecting heavily traveled rural highways and the principal arterial streets carrying intra-city traffic, to be designated by the city authorities subject to the approval of the State Roads Commission.

More adequate travel facilities for all motor vehicle users will result if a degree of cooperation and coordination is established through a state agency removed from local influence.

The law governing the acquisition of rights-of-way needed for present and future highway improvements should be modernized and made more workable. The adoption of a long-range construction program will permit the acquisition of rights-of-way well in advance of construction, reduce right-of-way cost, and eliminate delays.

It is strongly recommended that an effective zoning law be enacted that will give the State Roads Commission the authority to protect the highways from encroachment, regulate the number of places of ingress and egress, and eliminate undesirable roadside development, including the erection of unsightly signs.

Conclusion

Based on the proposed allocation of state motor user funds, operating under the recommended administrative plan, with the continuance of federal-aid as at present, no diversion of highway funds, and with the increased revenues resulting from the recapture of a portion of the motor fuel tax refunds, and with revised truck registration fees—it is entirely practicable and possible to fulfill the proposed modernization program for the next 5 years and to modernize our highways by 1960.

The proposals summarized herein offer the people of Maryland an opportunity to obtain an integrated, modern system of highways at no additional cost, except to those relatively small groups now benefiting from inequitable conditions which should be corrected regardless of the need for better roads. Few states can foresee such a highway improvement program without an increase in taxation of the general public.

MATHEMATICAL ANALYSIS OF SOIL MECHANICS PROBLEM

Rule-of-thumb engineering for predetermining stresses and deflections in earth fills soon may be replaced by scientific determination, for a mathematical analysis has just been evolved for estimating the stresses and deflections of earth fills and highawy embankments with great exactness. Such estimates may be made for fills on both level and sloping ground.

The analysis, which is based on the assumption of an elastic medium, was evolved by Dr. D. L. Holl, mathematician of the Iowa Engineering Experiment Station, Ames, Iowa. It is explained in Bulletin 148 of the Station, just released. The bulletin presents a method of determining the surface deflections and maximum shearing stresses in a semi-infinite elastic medium, such as earth, induced by various surface loads.

Results from Dr. Holl's study indicate that the depth at which the maximum shearing stress occurs under a symmetrical trapezoidal fill resting on a semi-infinite elastic medium is approximately equal to one-half of the length of an equivalent rectangular load of equal intensity. Maximum shearing stress was found not to exceed 31.8 percent of the actual loading.

The study also found that when an elastic layer is supported on a rigid base, such as a rock foundation, the stress in the supported layer is dependent on the Poisson's ratio of the layer, and shearing failure occurs within the layer before it occurs at the rigid base. Surface deflections and deflections at various depths are evaluated, using Poisson's ratio equal to 0.25, for several types of surface loading.

Formulas are derived for the stresses and deflections which will occur at different depths in an elastic medium extending infinitely or supported on a rigid base.

The complete findings of this analysis are presented in a 56-page bulletin, "Plane-Strain Distribution of Stress in Elastic Media." A limited number of copies are available for free distribution and may be obtained from the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa.

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FORT WAYNE'S NEW AIRPORT

Concrete and Soil-Cement Runways Built on Carefully Prepared Subgrade

By F. L. SPANGLER, M.E.

Placing and Compacting Fill

THE new Fort Wayne, Indiana, municipal airport, christened "Baer Field," is situated about four miles southwest of the city limits on the divide between the St. Lawrence and the Mississippi river systems, its surface draining approximately half to the one great waterway and half to the other. It covers an area approximately a mile square—chiefly rolling farm land. Maximum variation in elevation is about 20 ft. All buildings, except one brick veneer house, all fences, and some 50 acres of brush and timber were removed by the city of Fort Wayne before grading was started. Runway paving was completed on Sept. 19, 1941; and it is expected that the apron and other features will be finished by Oct. 1. The port will be open for use about the middle of October, construction having taken a total time of 7½ months.

General Features

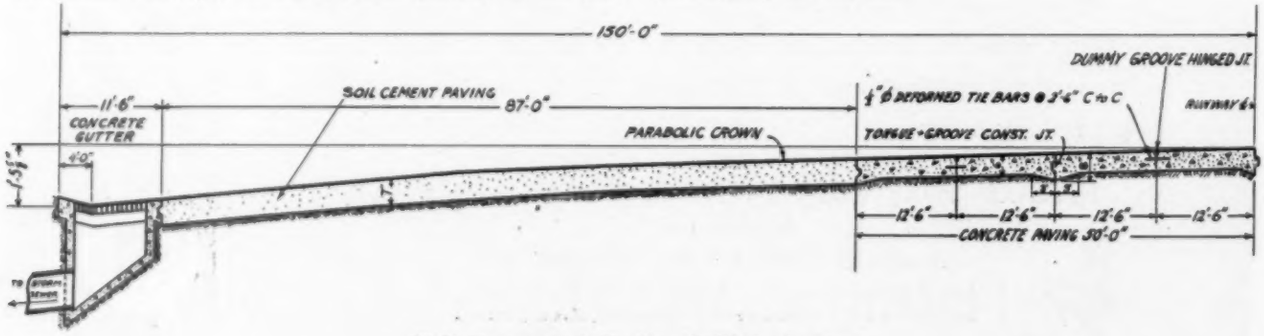
As shown by the map, the airport has two runways, forming a letter X with northwest-southeast and northeast-southwest directions. Each runway is 300 ft. wide, consisting of a 100-ft. concrete center strip with an 88-ft. strip of soil-cement on each side, and a 12-ft. concrete surface, gutter and curb along each outside edge. Near the north end of the area, between the two runways, is a concrete apron with five suitable concrete taxi strips connecting with the runways. At the south end of the area is a 150-ft. soil-cement runway connecting the ends of the two main runways. A north-south runway at the east side of the area is contemplated for future construction. Curbs are provided along the taxi strips and on the south edge of the apron, as well as on the runways.

An idea of the amount of concrete and soil-cement work on this project can be gained from the fact that the two combined are equivalent to the paving of about 39 miles of 25-ft. road.

The contract for the construction of the airport (exclusive of buildings and hangar) covered primarily the clearing and leveling of the site, installing a drainage system, laying concrete and soil-cement pavement, and topsoiling and seeding.

Equipment Maintenance

Much careful attention was given to maintenance of equipment throughout the work to make sure against delays, both large and small. One of the large factors in these provisions for efficiency was the selection of wire rope for use on the carrying scrapers, where service conditions always are severe. Only preformed rope of Lang lay construction with independent wire rope center was used for this purpose. Such rope has a maximum of durability under the high bending stresses caused by the small diameter drums and sheaves, resists crushing on the drums, is freer from twists and kinks than are other types, and is more easily and quickly cut and dead-ended. The extra care in equipment maintenance was amply justified by the results.



Half Symmetrical Section of 300-ft. Runway

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EUCLID THE PIONEER

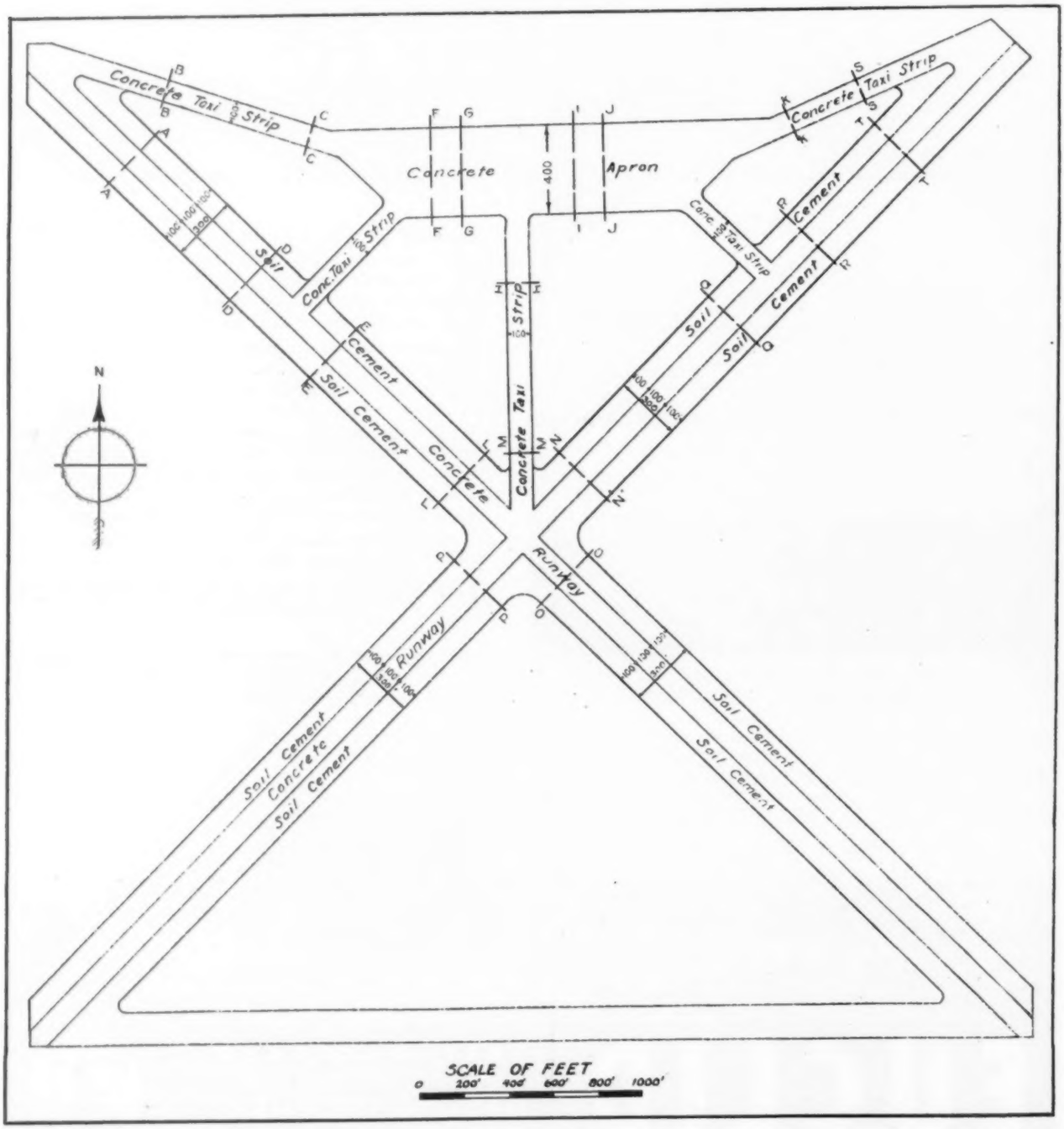
Grading—Density Control—Subgrade Finish

Excavation on this project involved a total of 1,300,000 cu. yd. of which 1,150,000 yd. was common and 150,000 yd. was stripping. The topsoil was stripped to an average depth of 9 in. from all areas to be paved, and all suitable topsoil materials were stock piled for later use.

After stripping, and after all stump holes and other cavities were filled, the runway locations were scarified and broken by disc harrows to a depth of 4 in. All roots, debris, and stones of 6-in. size or over thus exposed were removed.

To obtain maximum density of fill material, Proctor tests were made to determine optimum moisture for each of the various soils encountered; and the moisture content was held to within 2 per cent of this optimum on all compacted material. Results of a typical test are shown in the figure. Such tests were made at frequent intervals on embankment materials, both before and after compaction, and corrections, adjustments and modifications of methods and materials were made accordingly. All embankment constructed under this control proved highly satisfactory.

Embankment material was spread in layers not more than 6 in. deep. Where the moisture content was greater than optimum, the layer was cultivated with 24-in. disc harrows, operated in a tandem offset arrangement, until tests showed the desired moisture condition. Then the layer was rolled with sheepsfoot rollers pulled by crawler



General Plan of Runways and Apron

30 TONS—geared for fast action!

MACK BUILDS AN 8,000 POUND TRANSMISSION GIVING THIS MONSTER TANK A 35 M.P.H. SPEED!

Army M-3 tank, "land battleship" of America's modern mechanized army. Armed with cannon and machine guns.

The Army had to have a transmission—one capable of converting the speed of a 400 h.p. airplane engine into the smashing force of a 30-ton tank. ***Mack is building it***—a mighty 8,000 pound gearbox, the largest ever manufactured in quantity production—more than 300 times the weight of a passenger car transmission.

The largest trucks in Army service are gigantic six-wheel Macks. Great fleets of Mack dumpers are clearing the way for air-base construction at defense outposts. Mack skill and resources contribute in more than a score of ways to America's military might.

The Tough Jobs Go to Mack!

MACK TRUCKS, INC., NEW YORK, N. Y.

Mack

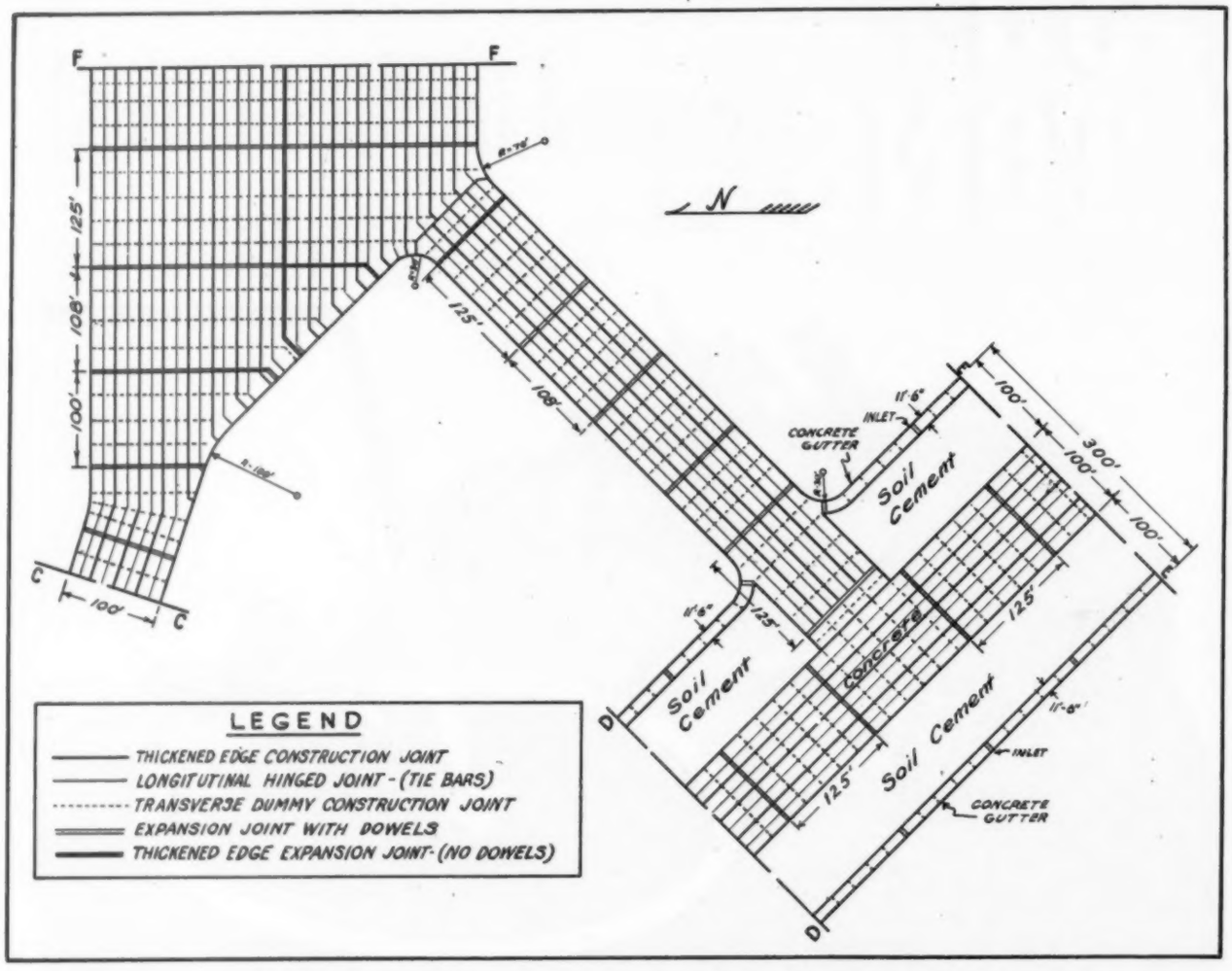
TRUCKS

1 TO 45 TONS

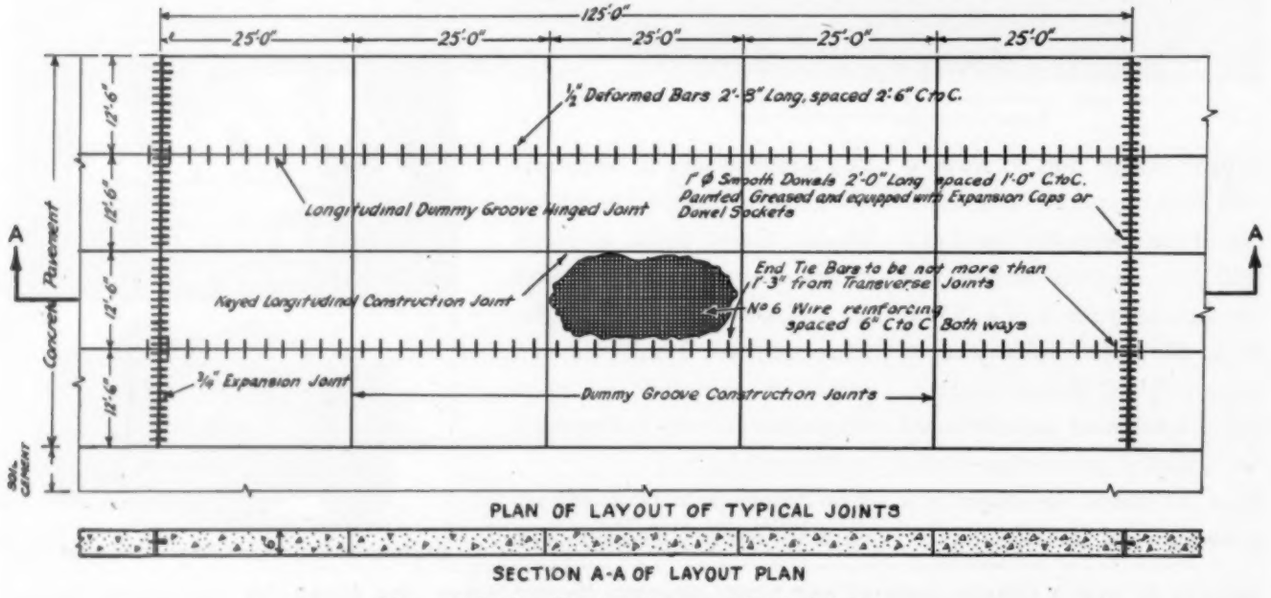
MAKERS OF WORLD-FAMOUS GASOLINE AND DIESEL-POWERED TRUCKS, BUSES, FIRE APPARATUS AND MARINE ENGINES

tractors. This equipment was selected for compacting in preference to rubber-tired equipment because of the nature of the heavy clay material.

The number of passes of the sheepsfoot rollers required to secure a compaction of 95 per cent Proctor maximum or better, depended on how near the material



Layout of Concrete Runway Intersections, Showing Jointing Arrangement
For Location of this Portion of the Pavement, See the Section Lines C-C, E-E, Etc., on General Plan
Similar Layout Details Are Given for All Other Intersections



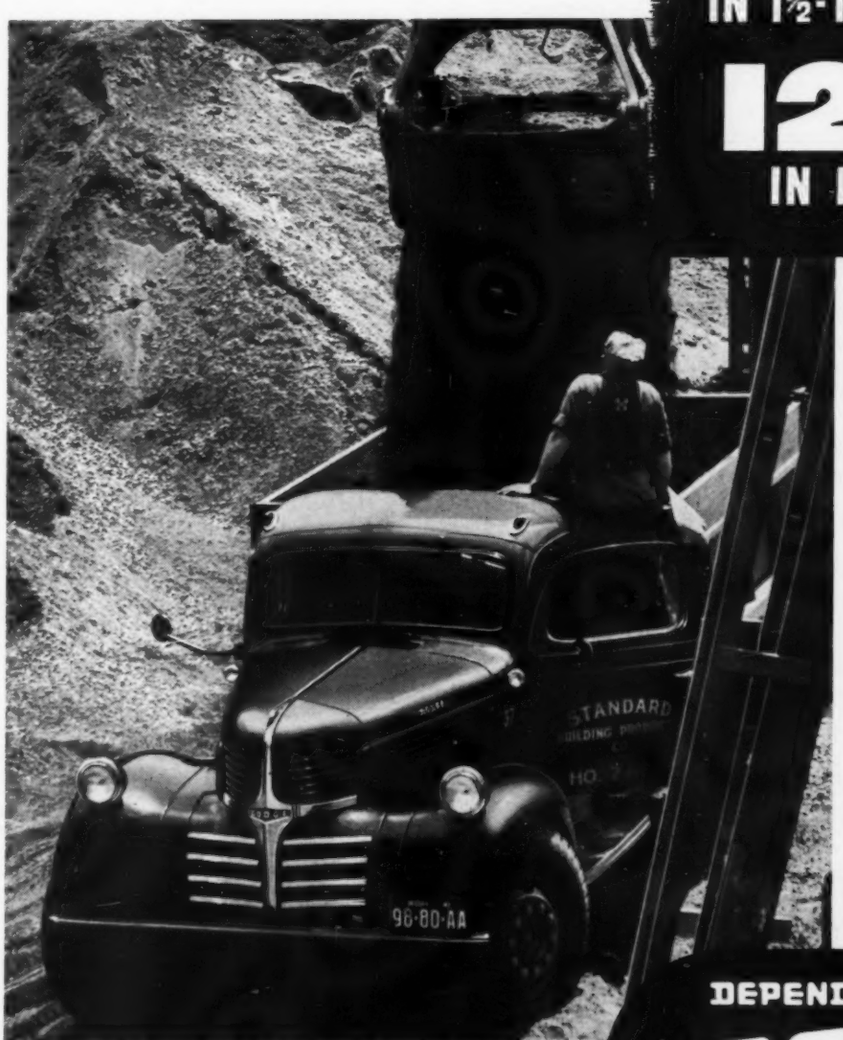
Plan and Section Showing Layout of Typical Joints

POWER speaks louder than words

NOW—

115 *horsepower*
IN 1½-TON DODGE TRUCKS

120 *horsepower*
IN 1½-TON SPECIAL



PLENTY OF POWER—in a truck that *fits the job*—means *extra* performance, *extra* dependability, *economical* operation and *extra long life!*

That's the kind of truck *you* want and *need* today—and that's the kind you get when you get the *right* Dodge *Job-Rated* truck to *fit your job*. See your Dodge dealer . . . *today!*

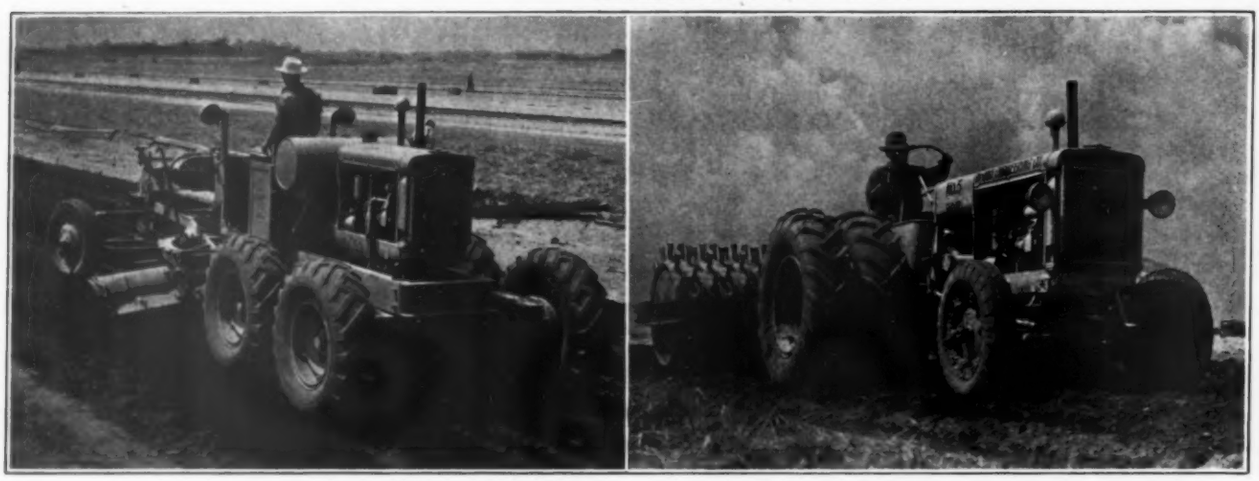
Prices and specifications subject to change without notice.

Better BECAUSE OF CHRYSLER CORPORATION ENGINEERING

DEPEND ON DODGE *Job-Rated* **TRUCKS**

DODGE PRODUCTS FOR NATIONAL DEFENSE:
Command Reconnaissance Cars • Field Radio Cars • Troop and Cargo Motor Transports • Weapon Carriers • Army Carry-Alls • Ambulances • Duralumin Forgings for Bomber Fuselages • Parts and Assemblies for Anti-Aircraft Cannons.

ADVERTISING PAGES REMOVED



Soil-Cement Surface Construction

was to optimum moisture content. Where the moisture was close to optimum, the material was compacted in as few as ten passes, but, with moisture 2 per cent above optimum, as many as 25 to 30 passes were required. Each roller unit consisted of four rollers, weighing 7,858 lb. each.

While excavation was in progress pockets of silt were exposed in various sections of the area, as well as pockets of sand and of clay. The existence of these pockets had not been revealed by the soil test holes made before the work was started. As silt pockets under runway foundations are likely to cause frost damage, all such material was removed to a depth of 2½ ft. below the top of the subgrade, care being taken that each scraper should pick up a load containing sand and clay as well as silt. These loads were stock piled and then deposited back into place in 6-in. layers and rolled in the same manner as the fill sections. This method produced a thorough mixing of the silt with the other soils and insured a high density, frost proof sub base at all points.

Runway fill densities on the completed job range from a low of 104 lb. per cu. ft. to a high of 111 lb., and average between 95 per cent and 100 per cent of the maximum Proctor densities obtainable. It is interesting to note that while the densities in the fill sections averaged approximately 108 lb. per cu. ft., the density of the clay soil in its natural state in the cut sections averaged only 95 lb. per cu. ft.

In the backfilling of pipe trenches across areas to be paved, the fill material was again compacted so as to obtain not less than 95 per cent of the test maximum.

In the cuts, the subgrade for both concrete and soil-cement surfaces was prepared by discing the clay to a depth of 3 in. and then mixing it with sand or sandy gravel, employing sufficient water to produce a friable consistency and insure uniform incorporation of the granular material with the clay. After the resulting layer was mixed, it was brought to the optimum moisture content and compacted to the required density by means of sheepsfoot rollers, blended and smoothed with a patrol grader during the rolling operation, and then rolled with a smoothfaced self-propelled tandem roller.

Drainage

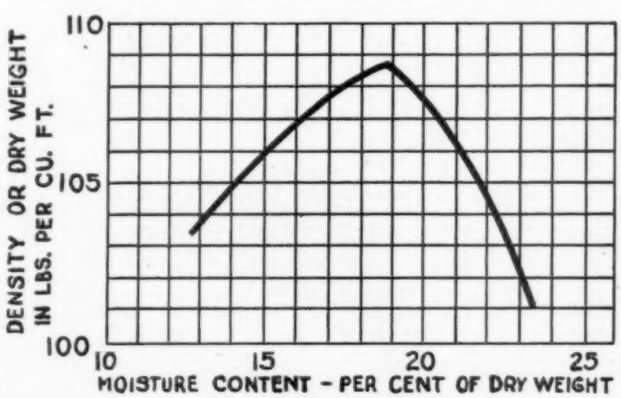
Storm sewers total 45,385 lin. ft. of 12-in. to 48-in. concrete pipe, with 72 brick manholes. Runoff on the unpaved areas is collected by some 10,450 lin. ft. of french drains with perforated galvanized pipe from 8 in. to 21 in. diameter, and by 14 ground inlets located at ponding areas in various parts of the field. These inlets are of concrete construction and are connected to storm sewer manholes by corrugated pipe of 12 to 24-in. diameter.

Two hundred and fifty-three gutter inlets spaced 150 ft. apart on runways, apron and taxi strips, receive the runoff from these surfaces.

Details of the ground inlets and French drains are given herewith. Most interesting feature in the latter is the strip of 10-oz. burlap separating the top 6-in. layer of gravel from the stone below.

Concrete and Soil-Cement Surfaces

Concrete pavements for runways, apron and taxi strips are 6 in. thick except at the joints, where they are 8 in. The mix, including that for curbs and inlets, was proportioned: 517 lb. of cement, 1,500 lb. of sand, 1,800 lb.



Proctor Test of Compacted Yellow Silty Clay on NESW Runway

Optimum Moisture 18.8%
Field Density 108.8 *lb. per cu. ft.*

of crushed limestone, with water not to exceed 5.5 gal. per bag of cement. All pavement concrete is reinforced with a mash of No. 6 wires spaced 6 in. center to center both ways.

The soil-cement strips are 7 in. thick. The cement totalled 7½ per cent of the dry weight of aggregate, which latter consisted approximately of 25 per cent top soil or strippings and 75 per cent of a well graded sand-gravel mixture obtained directly from a nearby pit.

Construction was by the road-mix method. Aggregates were placed on the subgrade between forms 20 ft. apart,

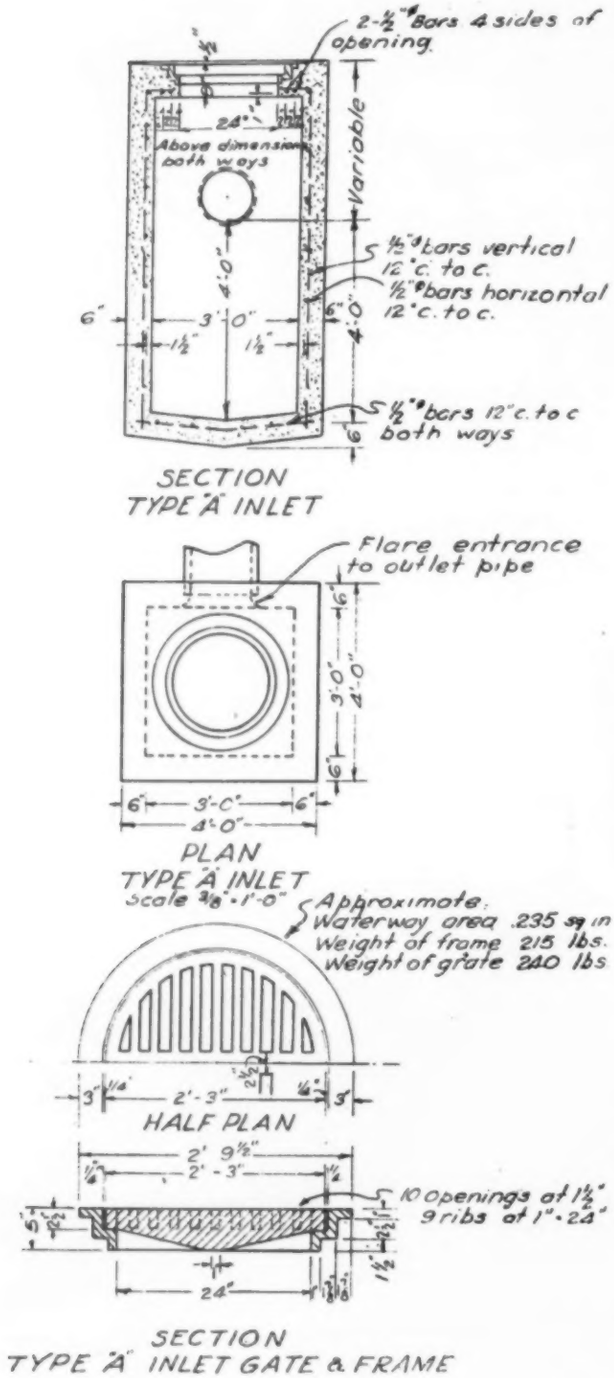
Above: International TD-14 Diesel equipped with a 9-foot snow plow with 9-foot wings. Owner covers a 90-mile stretch of roads and streets with this unit.

Above: Cleaning up deep drifts with the efficient TD-14, equipped with bullgrader. This equipment is owned by the city of Pittsfield, Mass.

Right: The powerful TD-18 cutting through big drifts in New England. The plow is a 10-foot size, with 12-foot wings.

—for Efficient Snow Removal

and cement was spread on the aggregates in proper proportion. The materials were then thoroughly mixed with disc and harrowing units, and brought to optimum moisture content by sprinkling. Compaction was by sheepsfoot rollers. The surface was shaped by graders, and finished with a smooth roller. The slab was cured for 7 days under a wet straw covering. Average compacted density of the soil-cement mixture is 124.5 lb. per cu. ft., and the optimum moisture content is 11.5 per cent. Thorough control tests were run by the Portland Cement Association and by the Michigan Highway Laboratory at Ann Arbor, Michigan.



Details of Ground Inlet

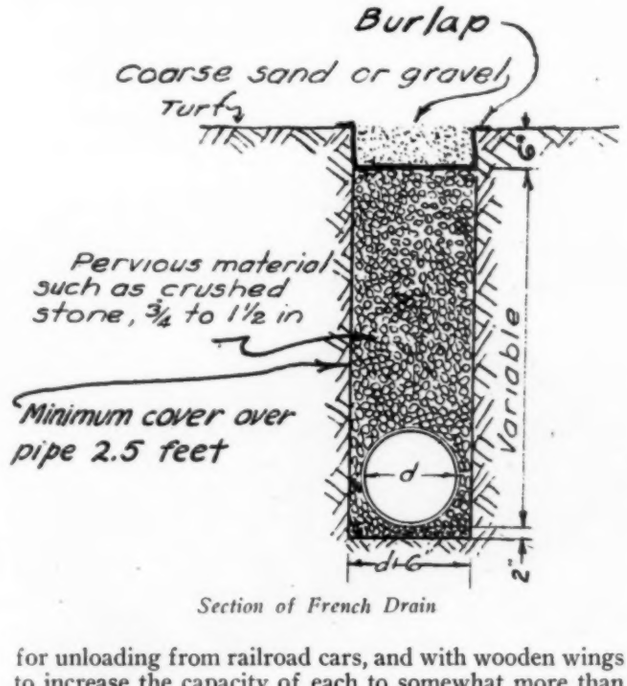
A seal coat consisting of ¼ in. RC cutback asphalt and limestone chips is applied to all soil-cement surfaces.

Contract—Personnel—Equipment

The contract for the airport job was awarded The Cooke Construction Company of Detroit, Michigan, by the Engineers Corps, U. S. War Department. Col. R. G. Barrows, Engineer for the Detroit, Michigan, District, is in direct charge of all work. Assisting Col. Barrows are T. F. Airis, project engineer, and H. E. Hill, engineer in charge of the airfield paving, grading, and drainage. The Cooke Construction Company sublet the grading to McVaugh-Haynes Company, Centerline, Michigan; concrete work to J. A. McKay & Sons, Inc., Farmington, Michigan; drainage to Drainage Contractors, Inc., Detroit, Michigan; and soil work to the Ohio Engineering Company, Lorain, Ohio.

Excavating equipment employed on the job consisted of five 18-yd. and four 14-yd. LeTourneau Carryalls; three Galion 15-yd. scrapers; two LeTourneau Turnapulls; a 15-yd. Euclid scraper unit; four sets of four J. D. Adams sheepsfoot rollers; three sets of 24 Killifer tandem offset discs; three bulldozers; two International tractors; and 13 Caterpillar tractors.

In the concrete paving equipment there are three Butler bins—one for unloading and storing cement, one for coarse aggregate, and one for sand. The two aggregate bins are provided with an Atlas belt conveyor



Section of French Drain

for unloading from railroad cars, and with wooden wings to increase the capacity of each to somewhat more than a car and a half. Other equipment includes a Koehring paver; Buffalo-Springfield roller, Jaeger F22 concrete spreader, Jaeger-Lakewood finisher, Jaeger form tamper, Flexible Road joint machine, Koehring longitudinal finisher, 12 Ford dump trucks, Buckeye crane, and a Caterpillar tractor for spotting incoming cars of cement, sand, and gravel.

Equipment used for trenching and backfilling for sewers and drains includes a Buckeye trencher; two Austin trenchers; a Northwest back hoe; a Lorain 75B crane; a Buckeye whirley; an Allis-Chalmers tractor with bulldozer; an International tractor with bulldozer; a Ford stake truck, and a Ford dump truck.

POST DEFENSE PUBLIC WORKS

Fifty-two cities and 19 states have begun long-range planning of their public improvements as a part of a program to build a reserve of public works for post-defense use, according to the National Resources Planning Board. The statement was made in connection with release of the Board's report "Long-Range Programming of Municipal Public Works," setting forth the experience of some of these cities and supplying a standard of programming procedure.

In cooperation with the Federal Works Agency it is sponsoring the Public Work Reserve, an operating project through which consultation and other assistance can be supplied to states and municipalities which are developing advance plans or programs of public works. The report just released is to be used as a guide by state and local government officials cooperating with the Public Work Reserve.

The cities in which demonstration projects were set up and new programming methods adopted were: Winchester, Massachusetts; Nashville, Tennessee; Kalamazoo, Michigan; Dallas, Texas; Fargo, North Dakota; Sacramento, California; and Spokane, Washington. Each of these demonstration projects culminated in the publication and adoption by municipal officials of long-range programs of local improvements.

Describing the methods employed in formulating such a program, the report says in part:

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CALIFORNIA CONSTRUCTION RECORDS

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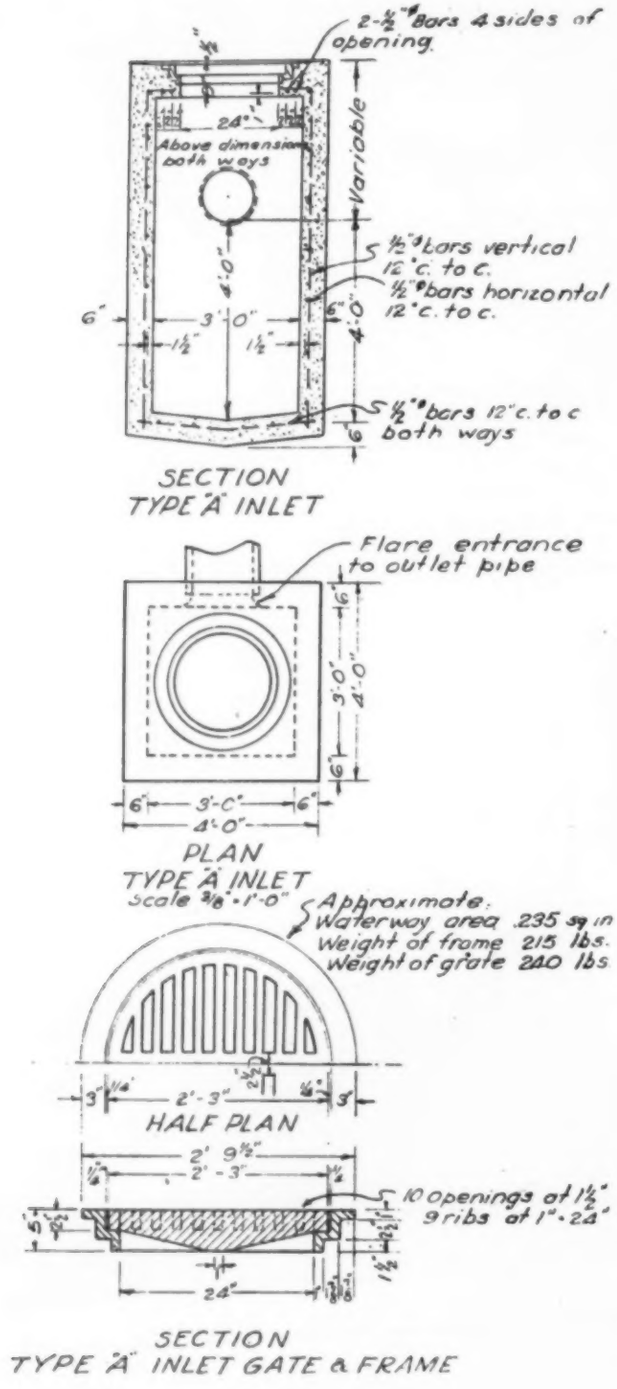

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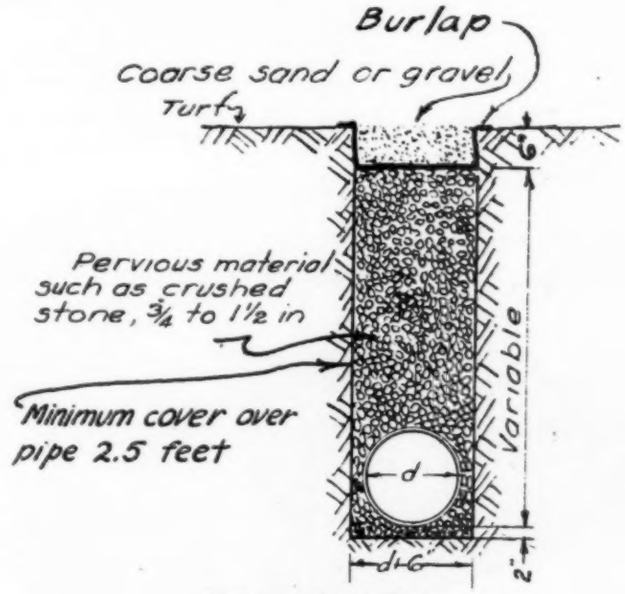

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Fig. 1 — Primitive Method of Constructing a Broken Stone Road in Korea

HIGHWAYS— THEN AND NOW

Mileposts in the Development of Modern Roads

By BEN H. PETTY

Professor of Highway Engineering, Purdue University

MACAULY, the historian, once said, "Of all inventions, the alphabet and printing press excepted, those inventions which *abridge distance* have done most for the civilization of the species." May we not legitimately assume that highways are included as "inventions which abridge distance?" At least they facilitate the abridging of distance for all who wish to travel.

A somewhat similar observation was made by Abbé Reynala many years ago when he said, "Let us travel over all the countries of the earth, and wherever we shall find no facility of trading from a city to a town, and from a village to a hamlet, we may pronounce the people to be barbarians; and we shall only be deceived respecting the degree of barbarism."

Apparently, since the dawn of history, the urge to "go places and see things" has motivated the human race. At first, travel afoot was the only choice. Later, in order to travel greater distances and incidentally to burn up less human energy per mile, man took to the waterways by log, by raft, by dugout and later by the more elaborate types of boats. But travel by water had its limitations and so, as a further development of the "theory of least work," man domesticated the four-footed animal, shifting his own weight and that of his pack to the animal's back, and started tramping out definite trails. Incidentally, we should not lose sight of the fact that on great areas of the earth's surface, to this day, pack animals and trails still provide the only, or at least the major, means of transportation for both men and goods.

Many of these pack animal trails were later widened and smoothed into roads to accommodate sledges which

* Abstract of banquet address at the annual meeting of the Upper Peninsula Road Builders' Association, Ironwood, Michigan, June 12, 1941.

Fig. 2.—Preparing a Road by Hand Tamping in Sumatra

Fig. 3.—Road Construction in Palestine. Note Donkeys and Camels Carrying Stone for Crushing

Steel Conserved by Preformed Wire Rope would build 2,095 Anti-Aircraft Guns

★ Each year American industry uses more preformed wire rope because it saves money by lasting longer, and saves time through fewer machine shutdowns for replacements. Operating men like it because it steadies production and increases safety.

★ Now all of a sudden, for another reason, preformed is tremendously important—because wire rope that lasts longer *conserves steel which America greatly needs.*

★ For example, the steel conserved this year by the longer service of preformed wire rope will be enough to build 2,095 anti-aircraft guns.

★ Buying and using preformed wire rope is patriotism industrialized.

PREFORMED WIRE ROPE

Ask Your Own Wire Rope Manufacturer or Supplier

Fig. 4.—The Late Henry B. Joy, President of the Lincoln Highway Association, and A. F. Bement, Vice-President, Marooned in a Mudhole on the Lincoln Highway in Nebraska Enroute to the Panama-Pacific Exposition in 1915

were superseded in turn by carts and wagons, after some great benefactor of mankind had developed that revolutionary gadget, the *Wheel.*

The Wheel

The origin of the wheel is lost in antiquity. Forbes places the invention of the wheel in Asia Minor, probably in Mesopotania, about 3500-3000 B. C. It is thought to have made its appearance in Egypt about 1600 B. C.

The backwardness of that mysterious country, Tibet, is attributed, at least in part, to the failure to utilize the wheel other than as prayer wheels, horizontal water wheels, and cable pulleys for moving boats or rafts across streams.

A news dispatch dated May 24th of this year commenting on the fact that the Soviet Socialist Republic

Fig. 5.—Horseless Carriages Had Not Yet appeared in 1891 *When the Village Council of Bellefontaine, Ohio, Warily and Doubtfully Authorized the Paving of Streets of Court House Square with a New-Fangled Material Called "Concrete." This Pavement Is Still in Use and Celebrates Its* 50*th Anniversary This Year*

of Tadzhik now has 8,000 miles of roads available for wheeled traffic states, "In some of the remoter areas of this republic—the first wheel ever seen was the wheel of an airplane. The first carts were brought there by tri-motored planes." Tadzhik is in a remote area of Central Asia having an area about equal to New York and New Jersey combined, with a population of 1,500,000.

Road Beginnings

A brief survey of some of the earlier roads or trails of which we have more or less authentic information may be of interest.

Gregory in his book, "The Story of Roads," states that "the presence of lapiz lazuli[1] in Egypt and in Ur indicates a trade route across Afghanistan, Persia, and Arabia in at least 3000 B. C.—The most precisely determined of the prehistoric long distance roads were those across West Central Europe for the trade in amber, important deposits of which were found along the Baltic and in Britain." These roads dating back to about 2000 B. C. were later extended across Poland and into Russia. The

Fig. 6.—Old Toll Gate House of the Cumberland Road (National Trail) Built in 1814 *at Addison, Pennsylvania*

log road reached its earliest perfection in a band of loess or marsh land through Poland and Germany which obstructed the passage of amber traders.

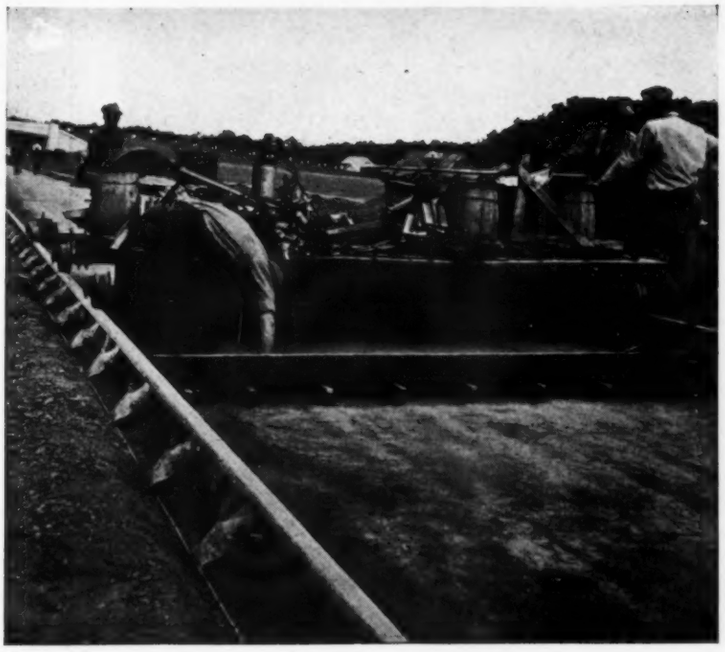
Brick roads or streets with asphalt filler apparently dated back to 2700 B. C. in India and Mesopotamia. In the latter, a road from Bagdad to Ispahan is still in use.

Dating back to about 2000 B. C. on the Island of Malta in the Mediterranean, roads were built with V-notches cut in stone slabs with about a 54-inch wheel gauge.

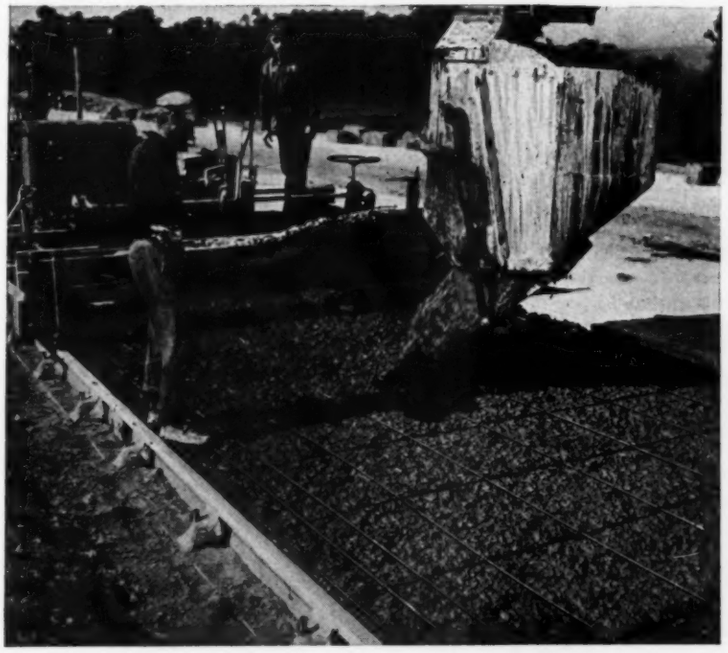
[1] Lapiz Lazuli is a stone of a rich blue color.—Ed.

Fig. 7.—An Antiquated Wooden Road Scraper Used in Southern Indiana Several Years Ago

Construction steps lively



WHEN YOU ORDER BETHLEHEM ROAD STEEL



When you order all your road steel requirements from Bethlehem, it's easier to keep highway construction moving smoothly.

Here's why that's true whether you're building a short connecting road or an interstate artery.

Bethlehem Road Steel Service supplies you with all the road steel products you need for any construction job. Bar mats, reinforcing bars, road joints, highway cable guard, steel posts, steel sheet piling and steel H-piling and many other products made by Bethlehem combine the latest design improvements with outstanding economy.

You save three ways by placing all your requirements for road steel with Bethlehem. Road steel is delivered when you want it. A single order eliminates unnecessary bookkeeping, correspondence or telephoning. A combined shipment usually saves you on freight charges, particularly when you can get delivery from a Bethlehem warehouse near you in miles and minutes.

Bethlehem has established a special service to handle your road steel requirements quickly and efficiently—to make sure you get better value for the money you spend on road steel. Before you start your next contract, write, phone or wire Bethlehem Steel Company, Bethlehem, Pa., and ask for details on Bethlehem Road Steel Service.

BETHLEHEM STEEL COMPANY

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Fig. 8.—Stone Road Marker Between Columbus and Fairfax, Indiana, Constructed in 1851 by H. Cross, a Cripple Unable to Do Manual Labor, Who Worked Out His Road Tax by Cutting Out Such Markers

There was a famous road on the Island of Crete which approached the best modern practice in its perfection of detail. It crossed the mountains at a height of 1,000 feet, and it is here that much of the original pavement attests the road building skill of the Cretians. (Providing these sections have not been obliterated by Stuka dive bombers during the past few days.) Forbes estimates this road was built some time before 2000 B. C.

The Valtherberg Road in Holland, about 1500 B. C., was built by using log stringers on which were fastened three-inch wooden planks.

As early as 800 B. C. roads were constructed of clay burned in place in India. This type of road construction has been revived recently in Australia.

The Greeks were poor road builders, but are credited with one paved road known as the "Sacred Way." The collapse of Alexander the Great's huge empire has been attributed to the lack of roads permitting adequate communication throughout his conquered provinces.

The Chinese have contributed but little to road building other than unpaved surfaces. In Gregory's writings on early road evelopment appears this statement: "In China a road is good for seven years then bad for 4000 years."

The Romans were probably the pioneers in large-scale building, starting about 300 years before the time of Christ. They are reported to have built some 50,000 miles of roads leading into their conquered provinces in Europe and Asia and to the Scottish border in Britain. They were used primarily as a means of transporting their armies and later used secondarily as arteries of trade. Many of these were high-type roads built up of successive layers of stone, some of them to a thickness of three or four feet. Sections of these roads are still in existence, one being the famous Appian Way from Rome to the sea coast. The Romans used cement in concreting some of their roads.

Fig. 9.—Fighting Mud 25 Years Ago on U. S. 52 North of Indianapolis, Indiana

In 50 B. C. the Roman senator, Cyro, proposed a road tax on vehicles which failed to pass the Roman senate. The Romans did develop one idea on financing highways which might pay good dividends in this country today. This plan involved the erection of mileposts along the roads on which the names of prominent cash contributors were inscribed. Such a plan might appeal to certain politicians, socialites, and others who crave the limelight, even in modern times.

In the Western Hemisphere the Incas and their predecessors in Peru built a remarkable highway some 4000 miles in length dating back to about 100 A. D. Much of this highway had a deep foundation, was surfaced with cut porphyritic stone and was 20 feet wide. A large portion of the highway was surfaced with asphalt, and was so well preserved that long sections of it are in use to this day.

Creditable road building was done by the Aztecs in Mexico. An expedition sponsored by Carnegie Institute recently discovered roads 30 to 34 feet wide, built of stone and cementing mortar. These were built by the Mayans about 400 A. D. and were the crude forerunners of the modern concrete road.

In St. Clair's writings we find this significant statement, "Transportation fell with Rome for more than 1000 years."

Fig. 10.—On Same Road as Fig. 9 After Paving With 3 Lanes of Concrete in 1939

Throughout the Dark Ages road building and maintenance were practically non-existent. Its big revival occurred during Napoleon's rise to power when again the roads built were for purposes of conquest.

Development of Scientific Road Building

Tresaguet in France during the last third of the 18th century was one of the pioneers in what has been called scientific road building. He reduced the common depth of pavements as previously used, laid a foundation of large stone, and arched the subgrade as well as the surface. He was followed in the first part of the 19th cen-

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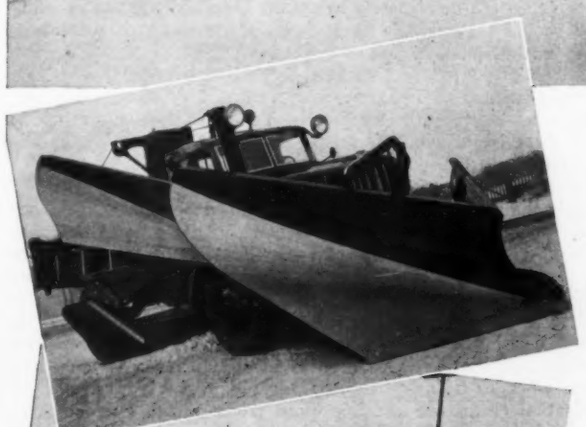

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tury in England by those two famous road builders, Macadam and Telford.

While most of the real progress in road improvement has occurred during the last generation, nevertheless, many of the basic principles of road improvement were developed more than 100 years ago and some of them many centuries ago. John Loudon MacAdam, one of the pioneers in the scientific development of road building in England in the first part of the 19th century, in his textbook, "Remarks on the Present System of Road Making," says, "The roads can never be rendered secure until the following principles be fully understood, admitted, and acted upon; namely that it is the native soil which really supports the weight of traffic; that while it is preserved in a dry state, it will carry any weight without sinking, and that it does in fact carry the road and the carriages also; that this native soil must previously be made quite dry, and a covering impenetrable to rain must then be placed over it, to preserve it in that state . . . . . ." MacAdam specified crushed stone, passing a one-inch ring, laid directly on the subgrade. However, crushed stone had previously been used extensively in Sweden and Switzerland.

MacAdam's emphasis of the fact that, after all, the subgrade finally must carry both the road surfacing and

Fig. 11.—*City Street (Muddy) in* 1914; *Passes a Court House in a County Seat.*

the traffic loads was apparently forgotten for a hundred years. With practically no concern for the subgrade, we have gone blithely ahead building road slabs of uniform cross-section design, mile after mile, utterly ignoring the fact that probably the subgrade conditions were changing every few hundred feet resulting in great variations in subgrade supporting power during the various seasons. Subgrade stabilization is now correcting this previously common error.

Thomas Telford ("The Colossus of Roads"), one of the greatest engineers of all time, was a contemporary of MacAdam, who devoted a share of his genius to road building. The following sections from his road specifications[2] were absolutely unprecedented in character, and while the coming of the motor car has modified them in degree, yet they have never been modified in principle.

"The business of tracing the line of a road should never be undertaken without the assistance of instruments; and all local suggestions should be received with extreme caution.

"To guard against errors in this important point, it is essentially necessary not to trust to the eye alone, but in every case to have a survey made of the country lying between the extreme points of the intended road. For this purpose an experienced surveyor should be allowed to survey and take the levels of all of the various lines that, on a previous perambulation of the country, appear favorable. It is only by such means that the best line can be determined. These surveys should be neatly and accurately protracted and laid down on good paper, on a scale of sixty-six yards to an inch for the ground plan, and of thirty feet to an inch for the vertical section. . . .

"A vertical section should be made, and the nature of the soil or different strata, to be ascertained by boring, over which each apparently favorable line passes, should be shown; for it is by this means alone that it can be determined and calculated at what inclinations the slopes in cutting and of embankments will stand. If it be necessary to cross rivers, the height of the greatest floods should be marked on the sections; the velocity of the water, and the sectional area of the river should also be stated.

"If bogs or morasses are to be passed over, the depth of the peat should be ascertained by boring; and the general inclination of the country for drainage should be marked. . . .

"All the gravel-pits or stone quarries contiguous to the line should be described on the map, with the various roads communicating with them, and the existing bridges over the streams or rivers which are immediately below the proposed point of crossing them should be carefully measured and the span or waterway, stated on the section. . . .

"A perfectly flat road is to be avoided. if it is not raised at least two or three feet above the general level of the land on each side of it, so as to expose the surface of it fully to the sun and wind; for if there is not a longitudinal inclination of at least one in one hundred on a road, water will not run off. . . .

"It may sometimes be proper to make a road deviate from a straight line in order to go through a town; but the expediency of such a deviation must wholly depend on the general object of the road. If it be intended to expedite the communication between two places of great trade, or otherwise of great importance, then nothing can be more erroneous than allowing the general line of road to be taken from the best and shortest direction in order to pass through a town. It is for this reason that little attention should be paid to the opposition of inhabitants of a town to new roads, when to be made for the advantage of the general communication of distant and important parts of the kingdom. . . . For let it be remembered that society is formed for the mutual and general benefit of the whole; and it would be a very unjust measure to incommode the whole merely for the convenience, or

Fig. 12—*City Street (Well Paved) in* 1941; *In Contrast to Mud Streets of Generation Ago Shown by Fig.* 11

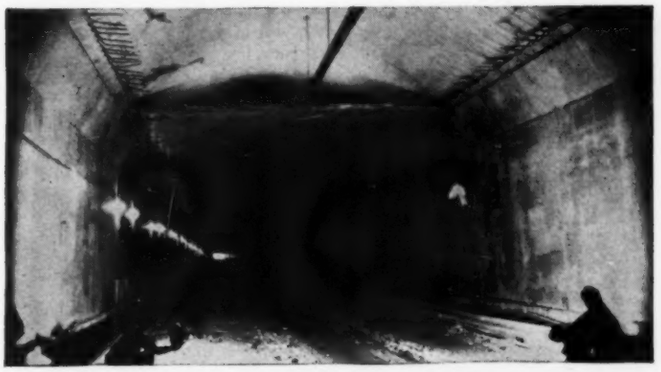
Fig. 13.—*Shortage of Bridges Still Handicaps Traffic at Many Places*

[2] A Treatise on Roads (London 1833) by Sir Henry Parnell.

FIGURE THE SAVINGS YOURSELF

...in FORM COSTS

How Atlas High-Early cement reduces form costs: This tunnel is 6,782 ft. long, 28 ft. 6 in. wide. Atlas High-Early cement in the 5" ceiling slab allowed earlier stripping and re-use of forms, saving two sets of forms, each 90 ft. x 28 ft. 6 in. Many days were saved. Protection and curing costs were cut. Sideling Hill Tunnel, Pennsylvania Turnpike. Chief Engineer, S. W. Marshall; Consulting Engineers, J. E. Greiner Co.; Contractor, Arundel Corp., Baltimore.



...in DAYS

How Atlas High-Early cement saves time: This, and three other culverts, were built in early spring. Five days after concrete was placed, forms were removed and the road opened. With standard portland cement the road would not have been opened for 14 days. Route 56, Vernon Co., Wis. Contractors, Nelson, Mullen and Nelson, Minneapolis.

...in PROTECTION and CURING

How Atlas High-Early cement cuts protection and curing: In paving this important downtown artery, five placements of concrete were made. Each required three days' protection and curing—a total of 15 days. Standard portland cement would have required seven days' protection and curing for each placement, or 35 days. Net saving—20 days. Water Street, Pittsburgh. Concrete contractor, Harrison Construction Co., Pittsburgh.

. . . your best bet's Atlas High-Early!

FIGURE IT OUT any way you like—in form costs, in days, in protection and curing—*this* cement pays on many jobs. It gains working strength rapidly, and cuts time required for protection and curing as much as 60% to 70%. It often permits earlier stripping and re-use of forms. It produces serviceable concrete in much less than usual time.

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ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

Fig. 14.—Even Telford and MacAdam, a Hundred Years Ago, Knew Better Than to Construct Roadside Ditches That Did Not Drain Properly

perhaps the gratifying of the whim or caprice of an individual."

Mr. Telford would be surprised to know that we still have some road men who are confident that they can build a grade or open up side drainage ditches by eye and consider the services of an engineer as superfluous.

Only within the last six or eight years have most state highway departments set up soils engineering divisions, and a great hullabaloo was raised over the discovery of something new in highway engineering. Yet Telford pointed out the necessity of soil studies in road building before we knew what a pavement was in this country.

Telford's remarkable comments on the alignment of highways, the by-passing of towns, and the "pressures" to be expected are almost uncanny. His specification for raising the road two or three feet above the general level of the surrounding land, of course, is an ideal aid to drainage and to prevention of snow drifts in northern climates.

Probably highway engineers could benefit from a careful reading of the historical development of road plans and specifications.

Roadbuilding in America

For 200 years, after the first settlements in Colonial America, roads were practically non-existent. Travel was confined largely to coastal waters and rivers by boat.

The Boston Post Road dates back to about 1763. Another famous early highway, known as the Wilderness Road, was laid out by Daniel Boone from Virginia through the Cumberland Gap into Kentucky. A historian describes this road as follows:

"The road marked out was at best but a trace. No vehicle of any sort passed over it before it was made a wagon road by action of the State Legislature in 1795. The location of the road, however, is a monument to the skill of Boone as a practical engineer and surveyor. It required a mind of far more than ordinary caliber to locate through more than 200 miles of mountain wilderness a way of travel which, for a hundred years, has remained practically unchanged, and upon which the State has stamped its approval by the expenditure of vast sums of money."

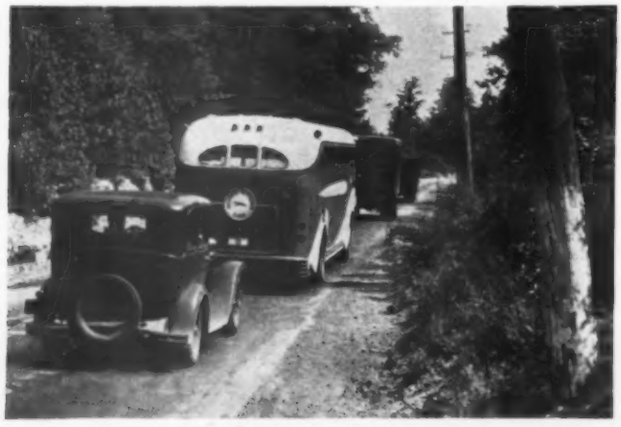

Fig. 15.—A Present-Day Congested Two-Lane Highway Calling for Expensive Widening

In 1796, Boone wrote as follows to Governor Shelby of Kentucky:

"Sir, after my best Respts to your Excellency and famyly, I wish to inform you that I have sum intention of undertaking this New Rode that is to be cut through the Wilderness, and I think my Self entitled to the ofer of the Bisness as I first Marked out that Rode in March 1775 and Never rec'd anything for my trubel, and Sepose I am no Statesman I am a Woodsman and think my Self as Capable of Marking and Cutting that Rode as any other man. Sir if you think with Me I would thank you to wright me a line by the post the first opportunity and he will Lodge it at Mr. John Milers on hinkston fork as I wish to know Where and when it is to be Laat (let) so that I may attend at the time I am Deer Sir your very omble sarvent.

DANIEL BOONE."

This is said to be the first attempt of an American "engineer" to break into "the contracting game." It may be said in passing, that, much to Boone's surprise and disappointment, the contract was given to others.

The first toll turnpike was the Philadelphia-Lancaster road constructed 1792-94.

Fig. 16.—A Beautiful Section of Modern Two-Lane Pavement with Lipped Curb on Grades

The National Road (now U. S. 40) represents the first governmental participation in road building on an appreciable scale. Congress authorized its construction from Cumberland, Md., to Wheeling, W. Va., in 1806 and construction was started in 1811. It was later extended into Indiana and surveys were completed into Illinois before it was abandoned by the government and turned over to the states through which it passed in 1856.

A bridge contract on a section of this road near Springfield, Ohio, in 1838 was let at 25 cents a cubic yard for excavation and 25 cents a yard-mile for hauling gravel beyond a one-mile free haul. The contractor was prohibited from subletting any of his work. An interesting clause in the contract stated, "The contractor shall not countenance use of ardent spirits by the persons in his employ."

Politics played an important part in the location of some of these early roads just as it does today. Bitter political battles were waged in determining the final location of the National Road. As an illustration, Albert Gallatin, then Secretary of the Treasury, sided with his former neighbors of Washington County, Pennsylvania, in this fight and in a letter to President Jefferson, he states that Washington County "gives a uniform majority of about two thousand votes in our favor, and if this

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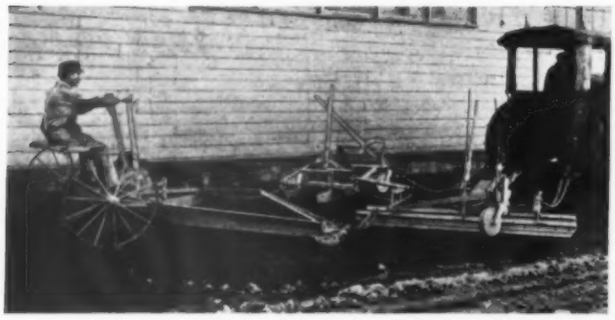


Fig. 17.—An Antiquated Road Maintenance Outfit—Yet, Not So Many Years Ago

be thrown by reason of this Road in a wrong scale, we will infallibly lose the state of Pennsylvania at the next election . . . . ." It may be said in passing that the road was located through Washington County.

Some of the trails laid into the far west early in the 19th century are of especial interest. There are no more thrilling annals in our pioneering history than the accomplishments of these path-finding, western pioneers who developed the Santa Fe (1921), the Oregon (1843), and the Overland (1848) trails, thus assuring the settlement and the holding for the United States of the great western dominions. The locations of some of these trails were so remarkably accurate that they are still, in the main, the principal routes of travel in those territories today.

Slow Progress

In view of the progress made in many other fields of human endeavor it is strange indeed that practically no increase in speed of travel occurred during the 4000 years ending with the early part of the 19th century. Father Abraham, 2300 years before the time of Christ could travel just as fast as George Washington, our first president. It required 12 days for Washington to travel from Philadelphia to Boston in 1775 to take command of the Continental Army. Fifty years later, 20 days were required for the famous Conestoga wagons to haul a load of freight from Philadelphia to Pittsburgh, a distance of 320 miles.

With the advent of the automobile in 1892 travel speeds increased as rapidly as the roads would permit. The development of the steam locomotive early in the 19th century was a further boost to travel speed. The first steam railroad in America was a southern line, the Charleston & Hamburg, which, when it reached the Savannah River at Hamburg, in 1833, measured 135 miles and was the longest railroad on earth.

In 1901 Roy D. Chapin created quite a stir in automotive circles by driving his Oldsmobile from Detroit to New York in 7½ days.

In 1903 a Winton, a Packard, and an Oldsmobile, on separate and independent ventures, made the transcontinental trip from San Francisco to New York in 74 days. The same year, the Wright brothers made the first successful airplane flight at Kitty Hawk, North Carolina.

The 1911 Glidden Road Race from New York to Jacksonville, Florida, a distance of 1454 miles, required almost eleven days of elapsed time for the winner.

Painful progress in the development of highway transportation is aptly illustrated by two short "travelogues" describing typical travel conditions in this country, one in the stagecoach days and one in the early motor vehicle era. A period of 72 years separates these experiences.

The first is from an article by E. I. Lewis entitled "Old Stage Coach Days" which appeared in the "Indiana Quarterly Magazine of History," describing a typical mud-road journey during early settlement days follows:

"On a Wednesday noon, in 1837, Thomas Goodwin, the well-known veteran Methodist preacher of Indianapolis, left Brookville for Greencastle to enter old Asbury (now DePauw) University. It had been raining. The old four-horse stage lumbered along at a slow rate and reached Bulltown, 17 miles from Brookville that night at 7 o'clock. Goodwin put up for the night. The next morning he found a butcher's wagon, without springs, a seat or cover—the stage—waiting at the door for him. The 50 miles to Indianapolis was one great quagmire and at 8 o'clock that night, when the 'stage' was still 6 miles from the capitol, an axle gave way. The driver took Goodwin's trunk ahead of him on the 'off' horse, and the contracting agent, with the mail in front of him and his passenger behind, rode the 'nigh' horse into Indianapolis, arriving at midnight and too late to catch the west stage. Goodwin had a day's lay-over, in which to inspect the new state house and the largest city he had ever seen. At 10 o'clock that night he climbed on the nine-seated St. Louis limited stage and started for Putnamville. The road was macadamized as far as Eagle Creek, but there the bogs were encountered again, and the stage came to a standstill. The eight male passengers were ordered out and sent to the near-by rail fence to get pries. They extricated the stage from the mudhole and were ready to get aboard when the driver announced that they had better carry those rails on down the road, for they would need them again. Plainfield, 14 miles out, was reached in time for breakfast and Putnamville at 4 o'clock. Goodwin reached Greencastle at 9 o'clock the next Sunday morning, having covered 124 miles in a little less than four full days and traveling two nights, at a total cost of about $8.00 or $9.00 fare and boarding and lodging."

About this time a migratory wag wrote these lines in the register book of a Franklin, Indiana tavern,

"The roads are impassable—hardly jackassable;
I think those who travel 'em should turn out and gravel 'em."

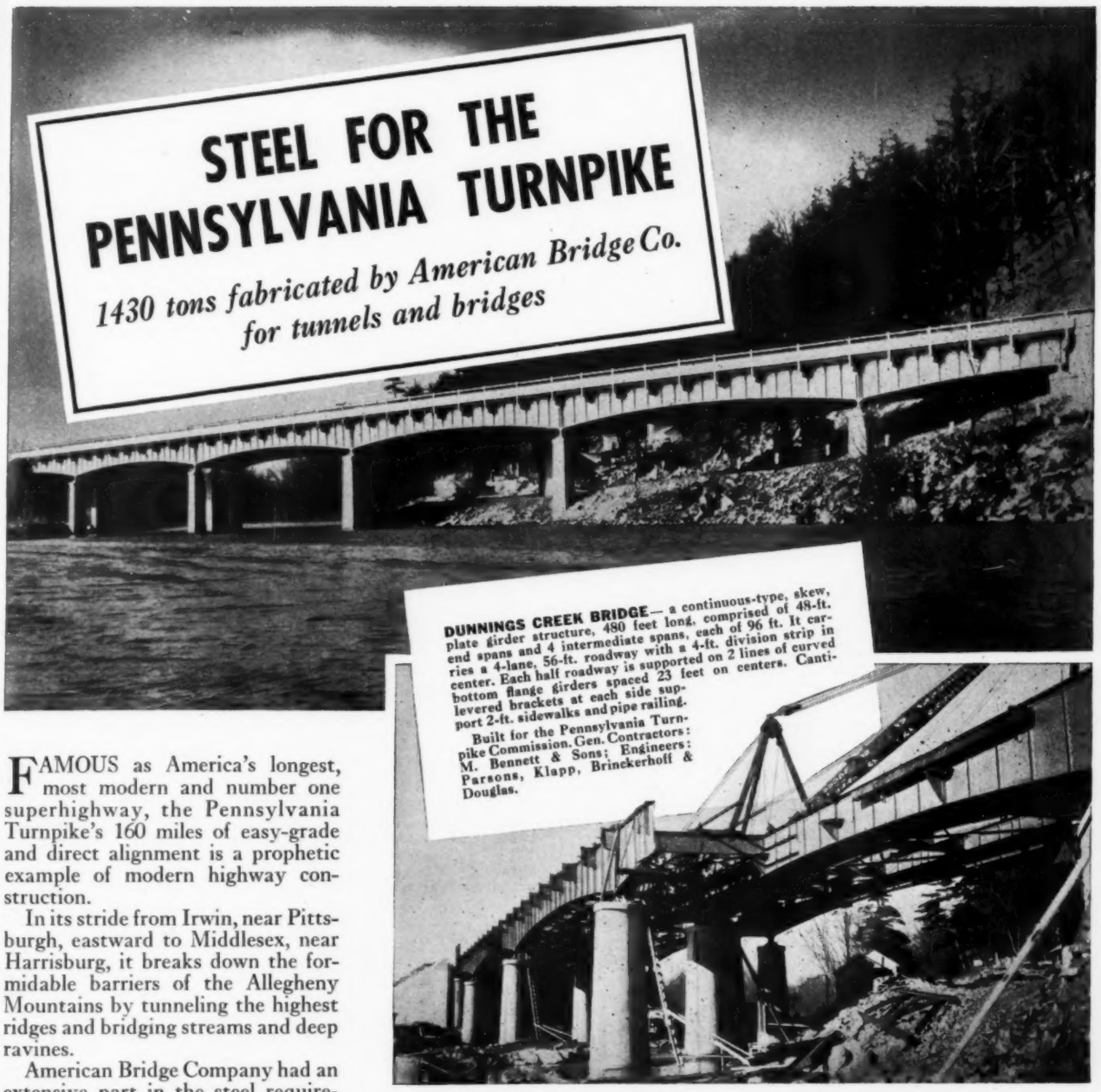
The second "travelogue" is taken from an address by Paul G. Hoffman, President, The Studebaker Corporation, South Bend, Indiana, at the 1939 Purdue Road School. It runs as follows:

"Thiry years ago this spring (1909) I was the chauffeur on the first long motor trip of the Hoffman family. The car was a 1905 Pope-Toledo purchased second-hand by my father at a cost of approximately $1500. It was an open car. The chassis would have done credit to Rube Goldberg. Advertisements called it the world's first mile-a-minute automobile. Tires cost from $75 to $90 apiece, were good for about 2,500 miles; punctures were frequent. A steering knuckle cost $30, and a new one was needed every so often. Springs, priced at about $30, broke every time you hit a bad bump. There were seven lugs on each wheel; to change a tire was a major operation. For touring we carried 16 spark plugs, all available inner tubes, two extra casings, tools enough to outfit a small garage. We lived in Western Springs southwest of Chicago. Our trip, for which we had to wait until spring, had as its destination Sycamore, Illinois, approximately sixty miles away. Preparations were made weeks ahead. We started bright and early on Saturday morning, with five people and an enormous hamper of lunch. Our adventures, briefed were as follows:

"In the first few miles I changed four spark plugs. Otherwise, everything was lovely.

"On the far side of the Fox River I tried to shift from third

Fig. 18.—Properly Constructed, Well Maintained, Gravel Road Presents Quite a Contrast to the Mud Road. Mixed-in Deliquescent Salts Help Compaction and Light Surface Applications Keep Dust Down



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1430 tons fabricated by American Bridge Co. for tunnels and bridges

DUNNINGS CREEK BRIDGE— a continuous-type, skew, plate girder structure, 480 feet long, comprised of 48-ft. end spans and 4 intermediate spans, each of 96 ft. It carries a 4-lane, 56-ft. roadway with a 4-ft. division strip in center. Each half roadway is supported on 2 lines of curved bottom flange girders spaced 23 feet on centers. Cantilevered brackets at each side support 2-ft. sidewalks and pipe railing.

Built for the Pennsylvania Turnpike Commission. Gen. Contractors: M. Bennett & Sons; Engineers: Parsons, Klapp, Brinckerhoff & Douglas.

FAMOUS as America's longest, most modern and number one superhighway, the Pennsylvania Turnpike's 160 miles of easy-grade and direct alignment is a prophetic example of modern highway construction.

In its stride from Irwin, near Pittsburgh, eastward to Middlesex, near Harrisburg, it breaks down the formidable barriers of the Allegheny Mountains by tunneling the highest ridges and bridging streams and deep ravines.

American Bridge Company had an extensive part in the steel requirements of this outstanding project, supplying 1430 tons of fabricated steel entering into tunnel construction and permanent bridge structures.

Of the five bridges that are American Bridge-built, the plate girder structure over Dunnings Creek, in Bedford Township, is of special interest. Esthetically pleasing in its simplicity of treatment and efficient use of durable steel, the Dunnings Creek Bridge was singled out by the Jury of Award of the American Institute of Steel Construction as the most beautiful "Class B" (cost range between 250,000 and 1,000,000 dollars) steel bridge opened to traffic during 1940.

Thus again is exemplified American Bridge Company's continuing participation, of more than a half century's standing, in the growth and development of America's steel-framed network of travel and commerce.

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UNITED STATES STEEL

to second gear to climb a hill, and failed. When the car was out of gear there was no service brake. We started to roll backward. My aunt screamed, tossed out the lunch basket, and followed it herself in a flying leap. I stopped the car by backing into the bank.

"After trying again and making the grade, we reached a fork in the road. Nobody knew which one to take, and we had no maps. Father said "left" and Grandfather said "right." Grandpa had the more positive manner, and we went right. We should have gone left.

"It began to rain. Considerable time was lost putting up the curtains. The road became a bog in which we finally sank. I cut brush to give the wheels traction. We got out of the first mudhole, went a short way, sank again.

"Night came on. I lighted the headlamps. Old-fashioned rock-carbide lamps, they flickered and flickered, went out. No help at all for seeing ahead. We slid into the ditch and were stuck for good. A neighboring farmer gave Mother and Aunt a bed for the night. My aunt nearly had hysterics because a woman had had her head chopped off in that house, and the farm wife insisted on telling her about it.

"Next morning we managed to get out of the ditch under our own power. We had come forty-five miles and had had enough; we headed for home.

"Presently the engine stopped cold. Trying to crank it, Grandpa gashed his forehead on the sharp top of the radiator. The cut bled freely. My aunt and my mother began to weep.

"I discovered what was wrong with the engine. A valve at the bottom of the crankcase had been turned when we were stuck in the ditch. The oil drained out, the engine 'froze'! I had extra oil and managed to start the engine, but we had burned out all the bearings, and I found that the engine would die if the car speed dropped below thirty miles per hour.

"At St. Charles, where we had started to roll downhill the day before, the two ladies got on the street car and went home. The nearest garage was at Aurora, fourteen miles away. We three men headed for it. We struck at least fifty 'thank-you-ma'ams' in the road between Aurora and St. Charles, taking them at thirty. Grandpa used most of his vivid vocabulary.

"The car stayed in the Aurora garage about a month and was practically rebuilt. . . .

"Motoring was like that thirty years ago."

Good Road Stimulation

Believe it or not, the League of American Wheelman (bicycle enthusiasts), organized in 1888, was probably the first effectively organized stimulus to road improvement.

The next great stimulus came from the organization of the American Road Makers' Association (now the American Road Builders' Association) on February 13, 1902, in the Cadillac Hotel in New York City, with Horatio S. Earle, Michigan State Highway Commissioner, its first president. This association held its first annual convention at Detroit on February 13-14, 1903.

In passing it may be well to cite again the fact that Wayne County, Michigan, pioneered *rural* concrete road building in 1909.

Probably the greatest stimulus of all came with the

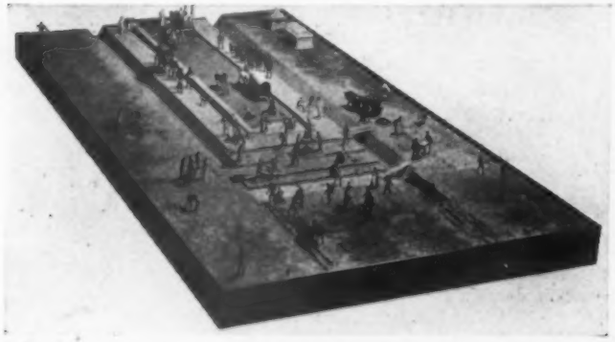

Fig. 19.—Photograph of Model Prepared by Public Roads Administration Illustrating the Construction of One of the Early Roman Roads. Photo Courtesy Public Roads Administration

Fig. 20.—Illustrating the Construction of a Telford Base in Maryland

passing by Congress of the Federal Aid Highway Act in 1916, under which the government alone has appropriated over 3 billions of dollars for highway improvement in regular federal aid and emergency grants.

In 1904 there were only 144 miles of high type pavement outside cities in the United States. Progressive road improvement and motor vehicle registration is shown in the following table:

ROAD MILEAGE AND MOTOR VEHICLE REGISTRATION IN THE UNITED STATES
(Bureau of Public Roads and A.A.S.H.O. Data)

	Rural Road Mileage			
Year	[1]Total	[2]Surfaced	High Type Pavement	Motor Vehicle Registrations
1904	2,151,379	153,530	144	55,290
1909	2,199,645	190,476	725	312,000
1914	2,445,761	257,291	14,442	1,711,339
1921	2,941,294	387,760	35,874	10,463,295
1930	3.009,066	693,559	125,708	26,545,281
1940	2,984,754	1,185,023	204,185	*32,452,861

* Includes 4,590,386 motor trucks.

[1] Totals are only approximate prior to 1940 when returns from State Highway Planning Surveys presented a fairly accurate picture of our road mileage and types.

[2] Includes "High Type." Accuracy as in note No. 1.

Up to Now

And now in this year of 1941 we have in these United States approximately 70 per cent of all the motor vehicles in the world and 30 per cent of the total road mileage. It may be of interest to know that in order to equal the total motor vehicle registration of over 1,500,000 in Michigan alone, one would have to add up the total registrations (U. S. Dept. of Commerce report as of Jan. 1, 1939) in the following 28 countries:

Afghanistan	1,550	India	106,951
Alaska	4,156	Italy	467,624
Albania	970	Liberia	125
Bolivia	3,613	Mexico	99,470
Brazil	170,300	Newfoundland	5,048
Bulgaria	4,706	Norway	90,687
Chile	43,905	Palestine	13,725
China	45,922	Poland	44,320
Czechoslovakia	73,168	Rumania	27,100
Egypt	33,806	Siam	11,185
Finland	45 588	Spain	125,000
Greece	14,000	Syria	11,594
Haiti	2,427	Turkey	11,117
Hungary	23,356	Yugoslavia	18,567
		Total	1,499,980

Grits for Highway Ice Control Should Be Prepared Now!

CALCIUM CHLORIDE IS YOUR BEST DEFENSE AGAINST

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  Calcium Chloride Keeps Abrasives Unfrozen, Easy to Handle and Spread
- • • **Excessive Costs**
  Treated Abrasives Do More Work Per Yard Yet Save in Handling Cost
- • • **Waste of Materials**
  You Use Less Abrasives and They Stay Longer

Stockpiling methods vary with individual needs. Some use huge piles like the 3500 cubic yard supply shown above, centrally located for redistribution. Others use carefully covered small local piles, bins for chute loading or long piles for increased loading access.

No matter which method you use, be sure to include calcium chloride. Thinner applications of treated abrasives will go farther, dig deeper and stick longer. Abrasives will load easier, spread faster and save labor. Now, before freezing weather, is the time to get your supply of calcium chloride and prepare stock piles for the winter offensive against icy roads. Literature explaining methods and amounts to use will be mailed at your request.

CALCIUM CHLORIDE ASSOCIATION
4145 PENOBSCOT BLDG. • DETROIT, MICHIGAN

lists a total of 2,984,754 miles of roads in the United States. The latest information I have been able to secure indicates that about six out of every 10 miles are still unimproved (mud) roads. It is true that during the past generation this country has experienced the greatest road building program the world has ever seen, nevertheless, we still have a tremendous amount of work ahead of us. In all probability this total of approximately three million miles of roads will never be 100 per cent surfaced, but it is quite evident to anyone familiar with our highway situation that the improvement and surfacing of several hundred thousand miles of rural roads is urgently needed in order to relieve thousands of communities of the handicaps on agricultural development, education, medical service, community life, etc., resulting from the lack of improved roads.

A survey of the 48 state highway departments in 1938 showed that a total of $3,664,296,000 would be required to bring our state highways and bridges as a whole up to present day standards. Some states have already reached the point where practically all of their present highway revenue is required for the maintenace and the rehabilitation of existing state roads, with little or no funds left over for additional new construction. This problem will become more serious as time goes on, due to the increasing mileage of roads which will have reached the end of their economical lives and will require complete resurfacing or rebuilding. The situation in the county road field is correspondingly serious.

A question frequently asked is, "When will our road job be done?" The obvious answer is "never." Back in 1924 the late Edward N. Hines, then chairman of the Wayne County (Mich.) Highway Commission, answered this question as follows:

"It will not be done until every mile of road in the county is improved; until every bridge is made safe and adequate in width; until pedestrian paths are provided on the trunk lines; until all grades are separated; until the system is lighted; until all the ditches are closed; until public comfort stations are provided to take care of the traveling public in a sanitary way; until all of our roads are planted; until we have numerous public parks and playgrounds; until all poles are off the highways and all wires are underground."

Thousands of road men scattered throughout the United States have the ability, initiative and courage to bring our highways to the desired standards of service and efficiency and to keep pace with developments in motor vehicles and traffic needs—with the very important proviso that they be supplied with the necessary funds. When the history of the first half of the 20th century in these United States is written, glowing tributes will be paid to the road men who have contributed so much to our country's advancement.

AED ANNUAL MEETING SET FOR JAN. 12-17, '42 IN CHICAGO

The 23rd Annual Convention of the Associated Equipment Distributors will be held Monday, Tuesday and Wednesday, January 12th through the 17th at the Edgewater Beach Hotel in Chicago. This was announced at the association's executive offices in Washington following a meeting of the AED executive committee recently in the nation's capital.

To present a greater opportunity for distributors and manufacturers to get together, AED, the only nationwide association of construction machinery dealers, is sponsoring "Distributors' Week" in conjunction with the annual meeting. The first three days will be devoted to business sessions and the balance of the week will afford time for manufacturer-distributor conferences.

President W. G. Morgan, of the Geo. F. Smith Co., St. Louis, has appointed First Vice-President T. W. Harron, of Harron, Rickard and McCone Co., San Francisco, Program Chairman. Mr. Harron, in preparing the program of activities, has arranged for Manufacturer Sessions on Tuesday and Wednesday, January 13 and 14, at 9 A. M. and Manufacturer Group Sessions for Tuesday, January 13 at 2 P. M. The sessions on Monday will be exclusively for AED regular members and the sessions on Wednesday for regular, allied and associate members.

CELEBRATE 100 YEARS OF SERVICE

On Friday, Sept. 19, a group of editors and publishers of trade magazines were the guests of John A. Roeblings' Sons Company at the observance of that organization's one hundredth anniversary. In this country an organization of such age is still a rarity but the Roebling company is unique in that it is one of the greatest one-family industries in America in which the family tradition for both engineering and financial ability has been carried on through three generations.

The guests were given a lunch at the Trenton plant and then conducted on an inspection trip through the plants at Roebling and Trenton. Dinner was served at Nassau Tavern, Princeton, at which Leon Henderson was the principal speaker. It was in this dignified manner that the Roeblings showed their just pride in their achievements during the past century.

SOUTH CAROLINA TRAFFIC CONFERENCE

The First Southern Traffic Conference was held at Clemson College, S. C., on September 9-12, with 160 delegates from 13 states and the District of Columbia. J. S. Williamson, State Highway Commissioner of South Carolina, was chairman. The paper by H. F. Hammond, Director of the Traffic Div. of the National Conservation Bureau, on "Traffic Engineering Accomplishments" was of great interest and widely discussed. Other papers presented and fully discussed were on "Field Studies and Accidents" by V. A. Rogers, Traffic Manager of Richmond, Virginia; "Traffic Congestion" by Maxwell Halsey, Director of the Yale Bureau of Traffic; "National Defense" and its problems was an open discussion and was joined in by Col. L. A. Page of the First Army Corps; A. W. Bolen, S. C. Highway Department; Capt. Mason of S. C. Highway Patrol; Virden Rittgers, ex-Traffic Engr. of Oklahoma; and A. Mitchell, N. C. Traffic Engineer.

"Defense Industry Traffic" by Capt. Wm. M. Angas of Charleston Navy Yard; Rear Adm. P. W. Foote, and W. F. Rosenwald discussed allied projects. D. G. Mickle, Traffic Engr., Mich. Highway Dept., covered "Parking Problems"; H. H. Harrison, Ill. Highway Dept. and W. K. Beckhan, discussed "Highway Signs and Markings"; Jos. Barnett of U. S. Bureau of Roads, and H. J. Blackman of So. Carolina Highway Dept., discussed "Modern Crossings and Highway Designs"; while E. J. Reeder, Traffic Engr. of National Safety Council, discussed Speed and Vehicle Problems.

The great success of the Conference called for another one in 1942, and a Resolutions Committee was appointed to work out the plans. Full reports of the meeting can be obtained from Prof. E. L. Clark, Dept. of Civil Engineering, Clemson College.

CONTRACTORS AND HIGHWAY OFFICIALS SPEAK—

"QUOTATIONS" from

CONTRACTORS—

OFFICIALS

County—

Your equipment specifications are very valuable ..... Vermont
It's a great book. Thanks for our copy ..... Iowa
There is never a day goes by but the book is in constant use in my office ..... Illinois
Every manufacturer should be in ..... Oregon
Very well covered for my purpose ..... Virginia
If coverage is as great in 1941, we shall be well pleased ..... Kansas
Have found equipment specifications very helpful, and have found a place for the Catalog close to my desk ..... New Jersey
Handy to locate manufacturers of different products, also make use of the construction data and tables ..... Kansas
Adequate and has all we need ..... Texas
Ground very well covered ..... Washington

State—

We find it of much assistance and use it frequently ..... Alabama
Catalog is in almost constant use in my office as a reference ..... Illinois
An excellent publication, containing valuable engineering data ..... Tennessee
You now have a good list of manufacturers and the data is more complete and better than ever before ..... Vermont
Heads of departments, city, county, WPA and contractors very often come to us for consultation and we find this book invaluable ..... Texas

City—

It is satisfactory and complete for our requirements ..... Ohio
I find your book very valuable to this department ..... Missouri
I would like to see every manufacturer who is worthy of a place in so valuable an asset to municipal purchasing ..... Illinois

Federal—

You have covered the field very completely .... U. S. Engineer's Office, Texas
This office is interested in obtaining two copies of the catalog ..... U. S. Engineer's Office, New Hampshire
It is requested that copy of Powers' Catalog be furnished this office—the one previously sent to us was forwarded to one of our secret Atlantic bases ..... U. S. Engineer's Office, New York
Please send copy of Catalog to me at above address ..... Area Engineer WPA, Louisiana

POWERS' ROAD AND STREET CATALOG

330 SOUTH WELLS STREET, CHICAGO, ILLINOIS

NEW YORK • CLEVELAND • SAN FRANCISCO

EDITORIAL

WATCH YOUR TIRES

AT THIS TIME, when economy of rubber supply is such an important defense activity, contractors and machine operators must find ways of increasing tire life on their scrapers, motorgraders, tractors, trucks and other equipment. Just a little more attention to where the wheels are going will reduce cuts and bruises. Easier and more skillful maneuvering in digging and hauling or scraping and pushing will accomplish results in the reduction of tire wear. Recapping and retreading should be thoroughly investigated and tires repaired before the fabric becomes injured.

Successful contractors have learned the value of starting out with adequate tire equipment and then continuing with an organized tire service program. These measures insure longer tire life and lower cost of operation because of two reasons: (*a*) reduction of direct tire expense, and (*b*) prevention of indirect losses caused by service interruptions when tires fail.

Economy in the operation of rubber-tired construction equipment is reflected, at times, in fuel consumption of the prime mover and in increased yardage handled. One effecting item is the tire pressure. On grading jobs where scrapers are used, contractors frequently employ 60 lb. inflation pressure on 18:00 by 24 tires. Tire companies ordinarily recommend 35 to 40 lb. inflation pressure as the maximum that can successfully be used and still maintain proper flotation, reasonable draw-bar pull, and obtain proper compaction.

Conformance with these requirements dictates, in some instances, a recommendation for larger-section tires to carry a given load at the lower inflation pressures. It is better to obtain ground contact, according to tire company engineers, through a flattening of the pneumatic tire and thus compress the supporting material rather than through a hard, high pressure tire which displaces the ground sidewise because of tire penetration. This action can only be obtained when the inflation pressure of the tire is approximately the same as the unit supporting value of the soil. It is desirable to obtain flotation, that is, reduce tire penetration. In so doing, fuel consumption is decreased, tire sidewalls are not so liable to be cut, and the prime mover, in many cases, can be operated in a higher gear. This will increase hauling speed and number of trips. Thus, it is evident that tire pressure is an important point to watch on grading work. Economy in tire consumption is mandatory, hence it is mandatory that skinners, operators, and superintendents watch their jobs and keep an eye on tire wear.

PROBLEMS IN SOIL COMPACTION

APPROPRIATE construction procedure for consolidating embankments and subgrades requisite to a successful application of theory is not so well understood even though soil testing procedures are quite universally known. There is not the whole-hearted cooperation on the part of the contractors in the application of the consolidation theories, with the result that there is a feeling in some quarters that full compliance with rigid specifications is excessively expensive and impractical.

The answer to this condition is education. Yesterday many construction procedures practiced today were considered to be "high-fallutin" theories which were entirely impractical. Education in the construction procedure requisite to obtaining the desired theoretical results effected the goal then just as it must with respect to embankment and subgrade consolidation. As more and more failures are traced to improper grading procedure and engineers tighten up on specifications and construction requirements, contractors and equipment men will develop equipment and procedures which will accomplish the desired end with little, if any, increase in original cost and with great resultant saving in maintenance and reconstruction expenditures.

One of the best ways to disseminate information on this new science and compaction practice is to interest manufacturers in the problem. Engineers should evaluate present practices and procedures and interpret them for the contractors and manufacturers.

The manufacturers' problem is one of reviewing present equipment and ascertaining how well it satisfies the requirements established by the engineers. It is probable that new equipment needs to be designed and manufactured to efficiently perform the function of soil compaction. It is not unreasonable to assume that with full cooperation between engineer, contractor, and equipment manufacturer, equipment and procedure can be developed for better fill construction without any increased cost except such increases as may be caused by war conditions.

In general, consolidation may be accomplished by any one of three methods: (1) Rolling, (2) Impact, (3) Vibration. Cooperative effort of engineer, contractor, and manufacturer will help develop new equipment and construction procedures for the efficient employment of one of these methods and will assist in educating the contractor and construction foreman in how to obtain desired results at the least cost.

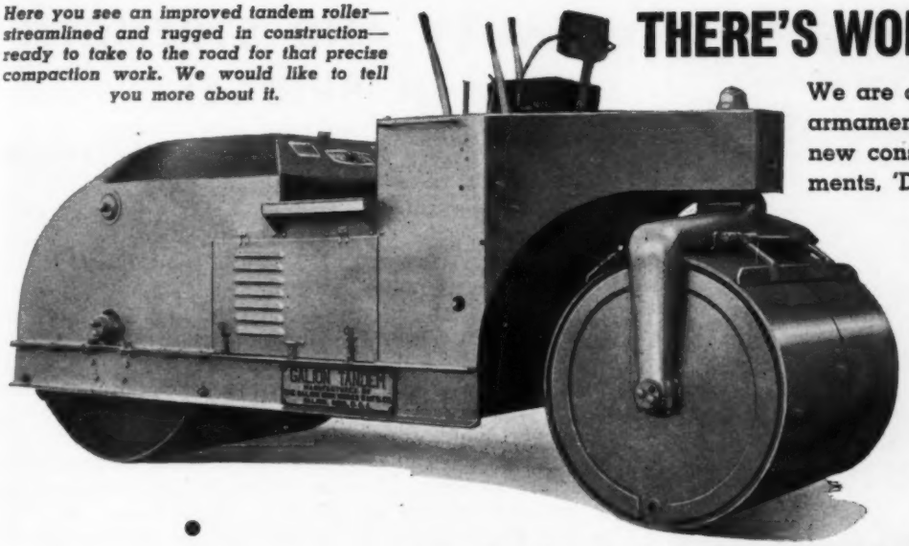
OFF-STREET PUBLIC PARKING LOTS

POSSIBILITY of stopping the fast descending values of property in certain so-called "blighted" areas in the central business districts lies, almost entirely, in providing off-street parking facilities. Kansas City is up against this problem now. Parking meters which they installed have not stopped the decentralization movement of business.

In many cities, most public officials and interested citizens, have reached the conclusion that no matter what a city's curb regulations may be, the demand for off-street parking lots remains the same. Whether or not these lots should be municipally or privately owned is irrelevant to this discussion. The point is that these off-street parking lots should be provided and there should be some guarantee of permanency for them in order that the locations may not be utilized for other enterprises. So doing would take away the advantages gained by local merchants who builded their businesses on the assumption that the parking lot would remain where it was established.

In Kalamazoo, Michigan, the citizens who are interested in the parking problem are definitely in favor of private ownership and operation of most everything. In the case of parking lots in the business section, however, they are as firmly in favor of public ownership because of the possibilities for permanency.

Here you see an improved tandem roller—streamlined and rugged in construction—ready to take to the road for that precise compaction work. We would like to tell you more about it.



THERE'S WORK TO BE DONE

We are on the march again . . . huge armaments program calls for a lot of new construction . . . airports, cantonments, 'Defense Highways' as well as repair work on existing projects.

Galion enters this picture nicely, and especially where precise compaction of road building material is the demand. For this exacting work we specially recommend the Galion tandem roller.

Two models—three sizes with weight variable from 5 to 14 tons. Diesel or gasoline power—hydraulic steering and other features to provide low-cost operation. You'll like this efficient unit once you put it to work . . . and we hope you will.

The Galion tandem is just one roller in the broad Galion line—others are: 3-wheel, portable, trench and sheepsfoot types in just the size and weight to take care of various kinds of compaction work.

Send for our complete roller catalog No. 240.

Also motor graders — three models with diesel or gasoline power, centralized fingertip controls, including steering — for ditching, bank-cutting, shoulder trimming—blading of all kinds. Send for engineering data.

THE GALION IRON WORKS & MFG. CO.

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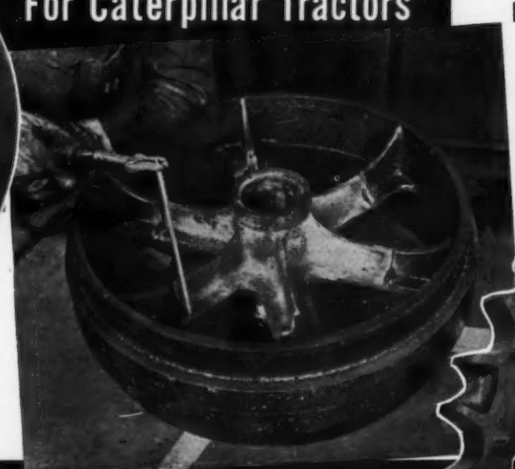
DURABLE MANGANESE STEEL

Renewable TRACTOR RIMS

For Caterpillar Tractors



When only the rims of those tractor drive sprockets and idlers have worn down, you'll save by welding on manganese steel renewable rims . . . They cost much less than the complete part and they're specially adapted for resisting destructive abrasive wear.

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One thing in highway construction you need have no fears about. When GOHI Corrugated Pipe is installed, it's there for keeps! It is enlisted for the duration of the highway, and it will never *soldier* on the job! GOHI possesses the ability to stand up under the most severe highway conditions: heavy traffic, settling and shifting fills, alternate freezing and thawing, abrasion and corrosion. So when roads are protected by GOHI it's a safe bet that the drainage structure will outlast the road! Get copy of 72-page illustrated GOHI Book, of interest to all road builders. Write the fabricator nearest you.

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BEAUTY AND STRENGTH IN BRIDGES

By CHARLES EVAN FOWLER

THE statement was made some years ago regarding the great Manhattan Bridge in New York that whatever was beautiful would be strong enough! There was no semblance of truth in the comment, and only the reverse is true—that whatever is strong enough can be designed so as to be beautiful, or at least pleasing. The suspension bridge and the arch are inherently beautiful in their general outlines, and other spans such as simple trusses, continuous girders, cantilevers, and draw spans can have one chord line of circular arcs, an ellipse, or a parabola to make the structure pleasing. The design for a long bridge must be an odd number of spans; a single span, like the perfect Hell Gate Arch by Lindenthal; or three spans like the beautiful Eads Bridge at St. Louis with its finely designed approaches; or the five spans of the writer's arched cantilever Gay St. Bridge over the Tennessee River at Knoxville, which observes all the fundamentals of engineering beauty—simplicity, symmetry, harmony and proportion; but a slight disregard of economy was necessary in this case to effect a satisfactory result. Sometimes a seven span structure is desirable for economy and beauty; but beyond this the necessity for an odd number of spans does not exist, as the eye does not include a greater number.

The details of design and decorations are of the greatest importance after the consideration of the ensemble. The proper widths, based on the basic proportions of the span length established by C. Shaler Smith, the great dean of American bridge engineering in the '80's, must be observed if the structure is to have sufficient lateral stiffness, while for vertical stiffness each span must have a depth of not less than one-seventh of the span length for simple spans, but increasing in depth as the loads become heavier. Suspension bridges used to be made with a sag of about one-tenth of the span length, but now one-ninth is usually employed for heavy bridges. The rise of arches is usually made quite deep, to fit the location or a mountain gorge, so that depths up to one-half are common. The great Hell Gate Arch of practically 1,000 ft. span, designed by Lindenthal with its beautiful span and towers, has a rise of 235 ft. It is also the heaviest bridge in the world, carrying four railway tracks for the maximum train loadings.

The Sydney Arch in Australia which is of the same general outline as the Hell Gate Arch, has a span of 1,650 ft. and a rise of 400 ft. The same beauty that is found in Hell Gate is naturally found here, and the finely detailed towers add much to the handsome appearance of this structure. It was designed by Bradfield, the engineer of the Public Works Department of New South Wales. The longest arch ever built was the Kill von Kull span of 1,675 ft., with a rise of 266 ft. This was a lattice rib design by Ammann, chief engineer of the Port of New York Authority, and with a graceful arch will be a more imposing structure as soon as the towers over the skewback abutments are built. The longest arch ever designed was a 2,850 ft. span, with a rise of 440 ft., by Max Am Ende, the one time noted English engineer. This was proposed as an alternate for Lindenthal's idea of a great suspension bridge over

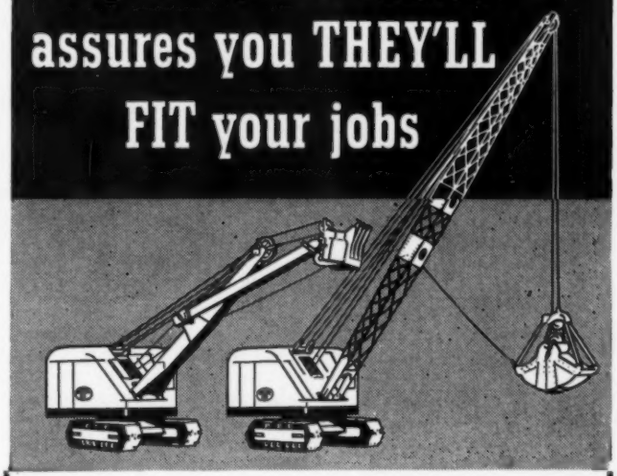
The Knoxville, Tenn., Cantilever

the Hudson River at New York City. This is referred to as showing the great arches that can be built for beauty.

The St. Louis three span arch over the Mississippi built in the early 70's has a center span of 520 ft. and a rise of about 80 ft. The chief engineer was James B. Eads, the noted American Engineer, who also designed the iron clad gun boats for the Mississippi during the Civil War, and the famous jetties at the mouth of this great stream. Prof. Woodward of Washington University was in charge of the design, and the bridge complies with all the basic fundamentals for beauty of bridge design including perfectly designed stone approaches with 3 finely designed arches at each end. Above each approach arch are 5 smaller arches to support the upper deck. The structure is also notable in having pneumatic caisson piers sunk to a depth of 110 ft., the greatest depth possible for the air process, and the greatest ever accomplished. The writer's arch in Alaska built in 1900 over a 250 ft. rock gorge at the summit of the mountains, 21 miles from Skagway on the White Pass and Yukon Ry. is still in use, and in fine condition after over 40 years' use. It was erected as a cantilever, with a total length of 400 ft., and a rise of 90 ft. The straight arch chords used in place of the usual arch curves are somewhat of an innovation, yet the structure is one of the most imposing ever built. The writer's 1,850 ft. Detroit suspension bridge to Canada was the longest span in the world when completed. The 3,500 ft. George Washington span over the Hudson River at 178th Street, New York City, soon followed, from designs by Ammann. Then the Golden Gate bridge at San Francisco of 4,200 ft. span was built, with the very narrow width of about 65 ft. The side sway of 30 ft. with a 90 mile wind was provided

The George Washington Bridge, New York City

Byers FLEXIBILITY assures you THEY'LL FIT your jobs



Byers full circle shovels and cranes will Hoist, while they Swing, while they Travel, while they Steer. Do you realize what this means on your jobs?

For instance, a dragline digs a section of ditch in a few minutes. Then it moves back to the next cut. If it's a Byers, it moves back while the operator is swinging to dump the last bucket load. Time saved, money saved, many times a day!

Or, maybe you've heard an operator cuss when he needed to swing a long boom to one side while steering toward the opposite side. This time saving Byers feature is an advantage to you whenever your crane or dragline must travel in crowded quarters.

Why don't you investigate a Byers now?

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Distributors throughout the world

Modern CRANES and SHOVELS

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The above screening plant turns out 400 tons of aggregate per day and is supplied with material from a gravel bar by a ¾-cu. yd. Sauerman Slackline Cableway.

Increase PROFITS by moving your material the SAUERMAN way

This view of a Sauerman Scraper-Loader at work shows the most effective method of loading from pits or stockpiles into cars or trucks.

Where loose materials (such as sand, gravel, blasted rock or ore, etc.) must be dug, hauled, and dumped at ranges from 100 to 1500 ft., the *economical* way to do it is with a SAUERMAN Scraper or Cableway.

These efficient machines haul 10 to 1000 cubic yards per hour, require only one operator, and demand little in maintenance . . . have been reducing costs on hundreds of dig and haul jobs all over the world for 30 years.

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488 S. Clinton St. CHICAGO

SAUERMAN LONG RANGE MACHINES

1941 sales records of Etnyre "Black Toppers" have soared to more than 100% increase over the former banner year of 1940. Thank you, Mr. Road Builder, for the confidence you place in the "House of Etnyre" . . . letting us help you build roads for America's defense.

SEE YOUR DEALER or write direct for FREE copy of Etnyre's catalog "FOTO-FACTS." Find out why *better roads* can be built at *lower cost*, at *higher speed* with "Black Toppers." E. D. Etnyre & Co., Oregon, Illinois, U. S. A.

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for in the 4,200 ft. span as built. The towers are of fine design and very imposing but would have been much enhanced if the width had been much greater.

The Goat Island bridge across San Francisco Bay has three 2,310 ft. spans over the main channel.

The Williamsburg bridge over East River at New York City has a span of 1,600 ft. which is slightly longer than the original Brooklyn Bridge. The towers are battered or lean inwards above the roadway. The Manhattan Bridge of 1,470 ft. span, is of quite chaste design but just missing beauty by having too abbreviated finials.

The two European suspension bridges worthy of mention are, first the Elizabeth Bridge at Buda Pest of 951.2 ft. span and a sag of 96 ft., has eye bar cables, which were assembled on elaborate falseworks. Lindenthal of New York was consulting engineer, as he had made extensive researches on eye bar cables. The towers are quite beautiful of chaste design, and the anchorage pylons are beautiful examples of masonry design. They were added afterwards to stop the sliding of the anchorages towards the river by adding weight in this manner.

The other notable one is the London Tower bridge over the Thames, with great and finely designed towers to harmonize with the near by old Tower of London. The center span is a double leaf bascule, with a half suspension span on either side of riveted construction, which are tied together across the foot bridge between the tops of the Towers. The ensemble is the most imposing of any bridge in the world.

POWERS' CATALOG • COLUMN •

POWERS' Road and Street Catalog, published in April, 1941, contains detailed specifications for 14 classes of road building and maintaining equipment (pages 176-247). Many different makes are listed in each class. Changes in these specifications have been listed in ROADS AND STREETS. in its June, July, August and September issues. Changes reported between Sept. 1 and Oct. 1 are as follows:

Huber Manufacturing Co.

	Previous	Present Revised
ROLLER (3-wheel) 5 & 6-ton sizes		
Shipping wt. (5-ton size) . . .	. . . . .	10,000 lb.+
Shipping wt. (6-ton size) . . .	12,402 lb.	12,000 lb.+
Third Speed—M.P.H.	. . . . .	4.5
Front Roll Diameter	24 in.	34"
Roll Overlap (each side) . . .	2½ in.	2¾"
Steering	Hand-Hydro.	Dual**
ROLLER (3-wheel) 7 & 8-ton sizes		
Length without scarifier (7-ton size)	157 in.	181½"
Engine Model (Buda)	H-326	Hivelo
Engine Displacement	326 cu. in.	298 cu. in.
Third Speed—M.P.H.	. . . . .	4.5
High Speed—M.P.H.	4.5	9.7
Steering	Hand-Hydro.	Dual**

**Operator can use either hand-hydraulic or power steering at will.

Ransome Concrete Machinery Co.

CONCRETE PAVING MIXER—34-E Dual Drum

This machine is now available with Cummins Diesel HBI-600, Buda Diesel M-766, or Hercules Gas HXE power unit.

LUBRICATION OF SNOW REMOVAL EQUIPMENT

Snow removal equipment must be ready to move the minute snow starts to lay on the roads. Proper maintenance calls for close attention to the lubrication requirements of this equipment so that there may be no delay when the time for snow removal arrives.

Engine crankcases should be drained and flushed and new oil of the proper grade placed in the engine at the time equipment is prepared for the road. A high quality oil having sufficient body or viscosity to lubricate properly under high operating temperatures encountered in heavy duty work must be used. The oil must have a low pour test and flow freely at low temperatures, as this equipment must frequently be stored either in the open or in unheated garages.

Provision should be made for maintaining proper engine operating temperature. Cold running engines have a greater tendency to condense moisture from blow-by gases in the crankcase. This moisture may in turn cause the formation of excessive amounts of sludge when mixed with oil, soot and dirt in the crankcase.

Transmissions and final drives should be drained and refilled with new lubricant of the proper type and grade. The lubricant must prevent metal to metal contact of the gears under heavy duty operating conditions and shock loads found in snow removal service. The lubricant should not offer excessive drag when cold.

All chassis points should be properly lubricated. On crawler type equipment, special attention must be given to the lubrication of final drives, track rollers, idlers, etc.

Hydraulic equipment should be checked to make sure that the proper hydraulic fluid is in the cylinders. All open linkage should be lubricated to provide easy operation and freedom from rusting.

Lubrication is one of the most important points in preparing snow removal equipment for service and no detail should be neglected.

National Airport Conference To Be Held in Chicago.—With a group of more than 15 prominent engineers, executives and operations men of air lines, airports, and State and Federal agencies already listed as speakers, plans for the first national airport conference are well under way. The conference is sponsored by Illinois Institute of Technology in Chicago Oct. 30 and 31, 1941, in the Palmer House. The project is under the direction of J. B. Finnegan, professor and chairman of the department of fire protection engineering at the Institute.

Boy Scouts Aid Traffic Survey.—Eight thousand Boy Scouts helped the Cook County Illinois highway department conduct an origin-destination traffic survey in the Chicago area on Sept. 9. The survey extended throughout most of Illinois and into northern Indiana.

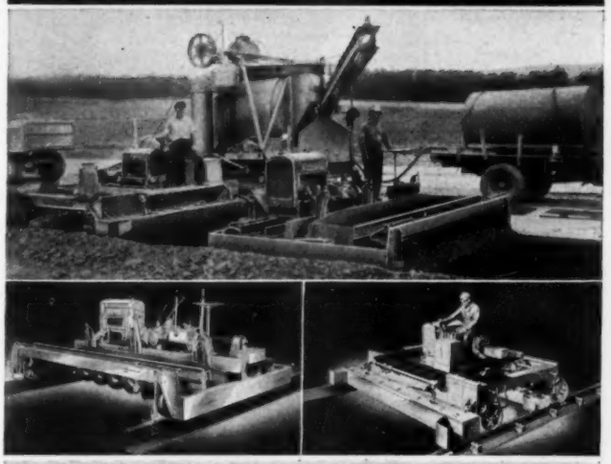
EDWARD W. ROTH ENTERS CONTRACTING BUSINESS IN CHICAGO

Edward W. Roth, formerly general superintendent with the Elston Fuel Corporation at Chicago, has established his own excavating and grading business known as "Edward W. Roth," 3036 North Knox Avenue, Chicago, Illinois.

Mr. Roth's recent activities include excavation work for the Broadview, Illinois, railroad underpass, sewer and water line excavation for Chanute Field at Rantoul, Illinois, and grading work for the 3½-mile grade separation at Winnetka, Illinois.

PAVE AS FAST AS YOU CAN POUR— JAEGER

Team Lays All the Concrete Dual Drum Pavers Can Produce — Any Standard Width — Cuts Costs Behind Pavers, Big or Small



SCREW SPREADER TYPE "H" FINISHER

the Team that Paved Pennsylvania Turnpike — 25 Jaeger Screw Spreaders, 24 Finishers, Made Possible the Record-Breaking Pace!

FOR STEADY, HIGH PRODUCTION: This mechanized method, originated by Jaeger, knocks the "bottleneck" from paving schedules—has remixed, spread, struck off and finished as high as 274 lineal ft. per hour of reinforced 12 ft. slab, 9" thick, and up to 410 ft. where two Pavers, Spreaders and Finishers operated simultaneously in one lane. Harsh, vibratory mixes are no problem. You can gear production to the capacity of your paving plant.

FOR UNIFORM TEXTURE OF SLAB: Jaeger is the only Spreader equipped with Screw which positively re-mixes and densifies the material and spreads it well against forms. No stone pockets, none of the segregation of hand shoveling, minimum honeycomb, and density of slab approaching vibrated concrete, even without vibration.

FOR LOWER COSTS: In addition to increased production, one man, with Spreader, does work of crew in pit and does all work of striking off in front of Finisher. Finishing machine concentrates on producing smoother finish, saving on floating and final finishing costs. Ask for latest catalog giving full details.

THE JAEGER MACHINE COMPANY

223 DUBLIN AVENUE, COLUMBUS, OHIO

ON WIDER SLAB: 20-22 Ft. Spreader behind 34E Dual Drum Paver Operating at 70 Batches per Hour. W. L. Thon, Contractor, on Michigan Route 66.

Right: Type "H" Finisher behind 34E Dual Drum Paver, averaging ½ mile of 24 ft. Slab per 8 Hrs. on "Road to Tara," South of Atlanta, Ga.; Hardaway Contracting Company.

WORLD'S LARGEST MANUFACTURERS OF SPREADING, FINISHING EQUIPMENT (Concrete, Bituminous) -MIXERS, PUMPS, HOISTS, TOWERS

AFTER DEFENSE—WHAT?

Emphasizing the necessity for immediate national attention to post-emergency planning, the National Resources Planning Board has called on public and private agencies to start work now on the problem of transferring millions of men from "all-out production for defense to all-out production for normal living, when this war is over."

In a pamphlet—"After Defense—What?"—the Board expresses the view that "energetic and intelligent teamwork will make it possible for us to move from defense to peace while maintaining full employment" by increasing the national income, developing high standards of living and by planning "to make Up-Building America the keynote of the post-defense program."

"The real problems of war never arise until after the war is over," said the Board. "When this war is won we can lose everything we are arming to defend, if, in the transition to peace, we slip back to a low national income with its inevitable unemployment, suffering, chaos and loss of freedom. To discover ways and to work out plans for shifting from full employment for defense to full employment for peace is a matter of outstanding concern.

"In this program government must take a leading part because it is the only representative of us all, the common meeting ground of all interests, and one center of responsible coordinating power through which we can all act together."

The central objectives of post-defense planning are summarized in the statement as follows:

"1. We must plan for full employment, for maintaining the national income at 100 billion dollars a year at least, a point we shall reach by 1944, rather than to let it slip back to 80, or 70 or 60 billion dollars again. In other words, we shall plan to balance our national production-consumption budget at a high level with full employment, not at a low level with mass unemployment.

"2. We must plan to do this without requiring work from youth who should be in school, the aged who should be relieved if they wish it, and women who choose to make their contribution in the home, and without asking anyone to work regularly in mines, factories, transportation or offices more than 40 hours a week or 50 weeks a year, or to sacrifice the wage standards which have been set.

"3. We must plan to decentralize post-defense emergency activities as far as possible; to use to the utmost our system of modified free enterprise with its voluntary employment, its special reward for effort, imagination and improvement, its elasticity and competition; and to advance cooperatively under national and governmental leadership.

"4. We must plan to enable every human being within our boundaries to realize progressively the promise of American life in food, shelter, clothing, medical care, education, work, rest, home life, opportunity to advance, adventure, and the basic freedoms.

"5. We must plan to make Up-Building America the keynote of the post-defense program including both construction activities which will add to the National Estate and service activities which will end malnutrition, and increase the vitality, health, skill, productivity, knowledge and happiness of the American people, and thus add to our wealth and well-being."

Outlining the role to be taken by the Board in post-defense planning, the statement says:

"The National Resources Planning Board has been instructed by the President (November 12, 1940) to collect, analyze and collate all constructive plans for significant public and private action in the post-defense period in so far as these have to do with the natural and human resources of the Nation. In the discharge of this responsibility the Board will serve as a clearinghouse to gather ideas and plans, to stimulate appropriate independent action by other public and private agencies, to bring together individuals who are interested in harmonizing their views, and to furnish the President and the Congress with information on these matters.

"The elected representatives of the people will, of course, make the decisions on policies and methods for meeting the problems of the post-defense period. The Congress has already provided appropriations for the inauguration of needed studies and for the preparation of post-defense plans by various agencies in the Executive branch. As these plans are matured for public discussion and appraisal the Congress will determine the ways in which they shall be put into action.

"The Board will not attempt to make plans for other agencies within their field of independent responsibility. Rather, it will seek, as in the past, to persuade other agencies to prepare plans. The Board is instructed to gather these programs on behalf of the President. The Board needs and requests help and cooperation of official and unofficial agencies and bodies in assembling the plans for dealing with the needs of the post-defense period."

BRIDGE DESIGN COMPETITION FOR STUDENTS

The American Institute of Steel Construction has announced another annual bridge design competition, open to bona fide registered students of structural engineering and architecture in recognized technical schools of the United States and its possessions, and offers three cash prizes of $200, $100 and $50 respectively, for the designs placed first, second and third. Certificates, signed by the Jury of Award and Officers of the Institute, will be awarded to the prize winners and to those whose designs are given honorable mention. The subject of the competitive design is a steel highway bridge to carry a highway over a river crossing. A jury of nationally known engineers and architects will judge the competition on Feb. 18, 1942. Drawings must be received at the Executive Offices of the American Institute of Steel Construction, 101 Park Ave., New York City, not later than Feb. 10, 1942.

The Texas Highway Commission has issued an order that in registering passengers cars for the registration year 1942, and in successive years, no license plates will be numbered below 5,000, and further that the issuance of special series of license plates known as the "State Official Plates" will be discontinued.

This order means that in the future there will be no low license numbers issued by the Highway Department.

1940 Treated Timber Output Shows Increase.—The total volume of timber treated in 1940 was equivalent to 3,185,677,788 bd. ft., compared with 2,942,638,536 bd. ft. in 1939, an increase of 243,039,252 bd. ft., or 8.26 per cent, according to the 32nd annual report on wood treated and preservatives used in the United States, prepared by R. K. Helphenstine, Jr., of the U. S. Forest Service in cooperation with the American Wood-Preservers' Association.

DO YOU WANT LOW COST MAINTENANCE, TOO?

Use the "Exclusive Features" No. 101 Utility Spray Tank

Here is the Maintenance outfit with standard features that are extras on similar units. Packed leakless cock, Direct Drive from Engine to Pump, Fuel Pump not pressure tank, etc. For further details ask for Bulletin N-5.

BLACK TOP ROAD MAINTENANCE EQUIPMENT — LB — SINCE - 1900

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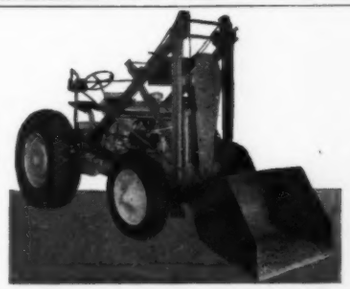
LITTLEFORD BROS.
454 E. Pearl St. Cincinnati, Ohio



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for Industrial Tractors
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Elkhart White Mfg. Co. Indiana

"BERG" HI-WAY SURFACER

A one-man, gasoline driven machine, for surfacing concrete roads, streets, floors and other concrete paving.

The Power Take-Off is an EXCLUSIVE FEATURE permitting attachment of "BERG" flexible shaft equipment, for surfacing walls, bridges, culverts, etc.

Pioneers in Concrete Surfacing Machinery.

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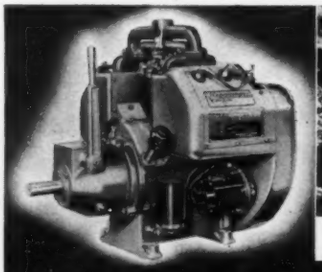
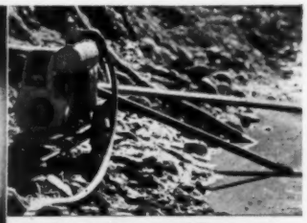
THE CONCRETE SURFACING MACHINERY CO.
CINCINNATI OHIO





Wisconsin-powered Pump on highway de-watering job

Built-in POWER TO FIT THE MACHINE AND THE JOB!

Illustrated is the sensational 4-cylinder **Model VE-4** 22 hp. engine. Weight, standard engine: 285 lbs.

Today, more than 300 manufacturers, in many industries, use Wisconsin heavy duty air-cooled engines either as built-in primary power or auxiliary power for their equipment.

Here is extreme compactness; light weight; air-cooled freedom from "weather grief"; economical operation . . . dependable power to fit *your* kind of equipment and *your* kind of work. Detailed data on request.

MOST POWER PER POUND — HEAVY-DUTY AIR-COOLED ENGINES

by WISCONSIN MOTOR CORPORATION
Milwaukee, Wisconsin, U. S. A.

World's Largest Builders of Heavy-Duty Air-Cooled Engines

ABOUT CONTRACTORS *and their* JOBS

KANSAS CITY AREA

Reported by
PAUL L. MATCHETTE

Construction Work Ahead of Schedule.—Camp Crowder is the new name given to the Neosho, Missouri replacement training camp now being built at Neosho, Missouri. The contractors, Tarlton-MacDonald Construction Company, of St. Louis, are doing a fine job and are ahead of schedule. M. L. Cunningham is general superintendent. Mr. Cunningham, before coming to Neosho, Missouri, was superintendent in charge of roads at Camp Shelby, Mississippi. Camp Shelby has some of the finest roads of any army camp in the country and Camp Crowder, located in the Ozark Hills, of southwestern Missouri, is fortunate to have a man of Mr. Cunningham's caliber to build its roads.

To Widen US 66.—Automobile and motor truck accidents on Highway No. 66, near Fort Leonard Wood, Missouri, so far this year total 454. Of this number, fifty-four deaths, including nineteen soldiers and 383 injured persons have been recorded. Of the 383 injured persons, 52 included soldiers from Fort Leonard Wood. Plans are now being made by both the military authorities and the state highway officials to make U. S. Highway 66 a four lane road in this congested area.

Freeman D. Martin Passes.—Freeman D. Martin, well-known contractor in eastern Kansas and western Missouri, died August 28 at his home at Fort Scott, Kansas. His wife followed him on September 10. Freeman Martin has been an active figure in the construction industry, especially in the building of roads and the production of aggregate throughout this territory for the past thirty years. For several years Mr. Martin was commissioner of streets at Fort Scott, Kansas.

Is Still in Hospital.—Will Shears, of J. H. Shears' Sons Company, Hutchinson, Kansas, last summer had a serious automobile accident, and has been in the hospital at Hutchinson for the past several months with a broken hip. We are all hoping it will not be long before Will will be out and back on the job, as we miss him at the Kansas Road Lettings.

J. H. Shears' Sons Company are perhaps one of the most successful road building and street paving construction companies in Kansas. The far-sightedness of Mr. J. H. Shears built an organization that is hard to beat. Three sons carry on. George Shears, the oldest of the three brothers, has charge of the finances and directs the policy of the company. Will Shears obtains the jobs and contacts the engineers. Frank Shears has charge of general construction in the field and has the reputation of being one of the best operators in the business. Besides laying concrete and brick pavement, they also operate an asphalt plant in the city of Hutchinson. They do extensive state highway road work, operating mostly throughout western Kansas. Besides this, they operate a large rock quarry and are interested in a sand producing plant. George Dunlap is general superintendent.

Takes New Position.—J. C. (Charlie) Schwenk, one of the oldest construction machinery salesmen in the southwest, is now in charge of purchases of equipment and supplies for Kiewits, Condon, Paschen Company, contractors building the new thirty million dollar Kansas Ordnance Plant at Parsons, Kansas. There is no other salesman in the entire southwest who has as many friends in the construction industry as Charlie Schwenk. After Charlie Schwenk was graduated from Washington and Jefferson University in Pennsylvania, he came to Kansas City and entered the construction machinery sales field in 1918. Good luck, Charlie! We are sorry to lose you in the sales field, and we all wish you the best of success.

General Contract Awarded.—A. Farnell Blair, of Decatur, Georgia, is awarded the general contract for the new Army cantonment near Fort Smith, Arkansas.

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HORIZONTAL DRILLS

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In the Coal field, the Iron range, the Utility and the Contracting field.

We build a model for every need.
Parmanco Drills are now in their fourth year of successful operations.

WRITE US YOUR DRILLING PROBLEMS

PARIS MANUFACTURING CO., INC.
PARIS, ILLINOIS

This new camp will be an armored division to house approximately 16,000 men. Mr. Blair's contract calls for a little more than fifteen million dollars. It is estimated that the total cost will be somewhere around twenty-five million dollars.

Western Construction Company, of Sioux City, Iowa, was awarded grading, bridges, and railroads. Koss Construction Company, Des Moines, Iowa, was awarded the concrete pavement, sidewalks, curb, and gutters. Michael Pontarelli and Son, of Chicago, were awarded the water, sewer, and gas. Ben H. Hogan, of Little Rock, was awarded the asphalt pavement. Work is now under way and everything is being done to have the job finished before spring.

Construction at Fort Sill Moves Rapidly.—I. V. (Vic) Gray, of the Standard Paving Company, Tulsa, Oklahoma, is making fast progress on the concrete pavement in and around the Fort Sill army camp near Lawton, Oklahoma. Vic has the contract for the hard standing areas at Fort Sill, also construction of essential roads at the Fort. Lieutenant Col. L. S. Woods is the quartermaster in charge. It is said that Col. Woods ranks as one of the best quartermasters in the United States Army. He has been very complimentary of the fine work that Standard Paving Company is doing at the Fort.

ST. LOUIS AREA

Reported by
O. B. AVERY

Happier Highway.—Illinois is seeking federal aid for a $20,000,000 four-lane roadway from St. Louis to Chicago, a highway suggestion which looks like a constructive proposal even in these times of emergency. The present road, "Old 66," carries a long line of trucks and automobiles by day and night on a two-lane pavement, which only broadens out to four lanes around Springfield and running into Chicago. This is a narrow right-of-way for motor traffic between the two largest metropolitan centers in the Middle West. sadder by comparison with the train service—probably the best out of the Atlantic Coast—and air service. The heavy traffic between St. Louis and Chicago needs a four-lane highway or, even better, north and south highways divided by a parkway. Governor Green can do a good deed downstate by improving "Old 66" and other highways of southern Illinois.

Contracts Awarded and Low Bidders on Illinois Work:

Contracts were awarded to the following on bids opened September 15th by the Illinois State Highway Dept.:

J. R. Burner, Oblong, Illinois, construction of four multiplate arch culverts (140 lineal feet) including R. C. headers, headwalls and footings in Wabash County, Mount Carmel, Ill., his bid being $5,279.00.

Amos Culbertson, Pana, Ill., construction of four reinforcement concrete box culverts, double 12′ x 8′, 12′ x 8′ and 10′ x 12′, on S. A. Route & 6, Sec. 178-MFT in Fayette County—$13,309.00.

C. J. Moritz, Inc., Effingham, Illinois, was low bidder on bids opened September 12th by the Illinois State Highway Dept., on .54 miles of patching on U. S. Route 50 east of Clay City in Richland-Clay Counties, his bid being $38,508.00.

Keeley Bros. Contracting Co., E. St. Louis, Ill., was also one of the low bidders at $56,334.00 on 0.91 miles of 22′ concrete pavement for reconstruction north of Waterloo in Monroe County.

Hoeffken Bros. Construction Co., Belleville, Illinois, were awarded contract by the Illinois State Highway Dept. on bids opened September 8th. Their bid of $10,-457.00 covered 0.182 miles of 54′ earth grading in Belleville along N. Douglas Ave. between Lebanon Ave. and No. Illinois Ave.

Cardinal Construction Co., E. St. Louis, Ill., was awarded contract for the construction of a pedestrian underpass under U. S. Highway 40 in front of the Collinsville Township High School in Collinsville, Ill., at bid price of $9,156.00.

On bids opened July 29th by the Illinois State Highway Dept., the following were among those awarded contracts:

Stocker Gravel & Construction Co., Highland, Ill., 3.51 miles of 22′ concrete pavement, relocation of Route 11, from S.W. of Highland, N.E. to N.E. of Highland—$195,990.00.

Fleming & Kilgo Construction Co., Alton, Ill., 4.73 miles of 22′ and 20′ concrete pavement, relocation of Route 11, from west of Route 150, Route 43 N.E. to N.E.

Say STOP and they'll really STOP!

THIS WAY

KEYSTONE SNOW PLOW LIGHTS

For Safer Snow-Fighting and Cindering

In one season, Keystone Snow Plow Lights can repay their modest cost by cutting down accidents and lawsuits. Many Highway Departments now use these lights to throw a powerful, flashing danger signal from the snow plow or cindering truck to all traffic, front and rear. Made of heavy gauge, lead-coated steel to withstand vibration and rust. Heavy, 6½-inch lenses. A sturdy, weatherproof light especially built and designed for snow plows. Furnished in Red and Amber stop—Red, Amber and Blue Plain Lenses. Write at once for full details and quantity prices.

AUTO GEAR & PARTS CO.

1410 W. Hunting Park Ave. Philadelphia, Pa.

of St. Jacobs in Madison County—$260,-231.00.

Hoeffken Bros. Construction Co., Belleville, Ill., 5.39 miles of 22′ and 20′ concrete pavement, relocation of Route 11, from junction 11 and 159, N.E. of Collinsville, N.E. to south of Troy, in Madison County—$299,816.00.

J. M. Driscoll, Decatur, Illinois, was low bidder at $12,353.00 on bids opened August 29th by the Illinois State Highway Dept. covering .30 miles of 27′, 47′ and sandstone rock asphalt binder course on State St. from Cedar St. northeast to Oak St. in Nakomis, Montgomery County, Ill.

At the August 26th letting of the Illinois State Highway Dept., H. M. Johnson, Mount Olive, Ill., was awarded contract on his bid of $40,094.00 covering 4.838 miles of 18′ gravel or crushed stone roads on Route 28 in Macoupin County.

Amos Culbertson & Sons, Pana, Ill., was awarded contract for the construction of three span bridge, 24′ roadway at Louisville, Ill., his bid being $15 333.00.

McCarthy Bros. Improvement Co., Davenport, Iowa, was awarded contract at $139,518.00 for the construction of a seawall, etc., at Rock Island, Illinois, along the Mississippi River, south bank, between 18th and 19th St., approximately 600 ft. long.

S. A. Healy Co., and M. J. Boyle Co., of Chicago, Ill., were awarded contract for the construction of a Shell Loading Plant at Carbondale, Ill., at approximate bid price of $15.000,000.

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Cantonments, ammunition plants, airports and other defense projects must be built quickly. Access roads must be constructed and snow removed. These are some of the jobs Baker Equipment is called upon to do and is doing well.

Throughout the years, Baker Bulldozers, Gradebuilders, Scrapers, Road Discs, Rooters, Maintainers and Snow Plows have served contractors as well as road and street officials. Baker has passed through many difficult pioneering days in developing its equipment and is proud, today of its achievements.

Even under the stress of defense production, every effort is being made to take care of normal requirements of Baker users and render "distinguished service."

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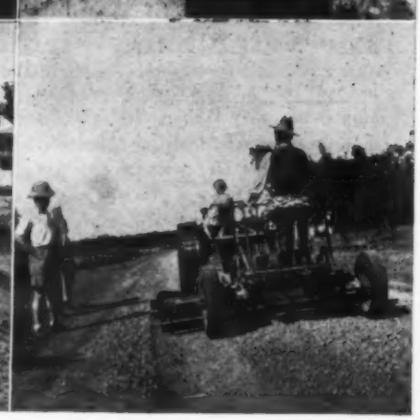
EQUIPMENT
FOR EARTH MOVING
ROAD MAINTENANCE
AND SNOW REMOVAL



Barter & Denny, Harrisburg, Ill., was awarded contract at the August 8th letting of the Illinois State Highway Dept., covering 1.24 miles of grading on Route 819 in Jefferson County—$23,312.00.

Contracts Awarded and Low Bidders on Missouri Work.—List & Weatherly, Kansas City, Mo., were low bidder at $18,684.00 covering bridge repairs of the Southern Railroad approach (Letting 5047) in St. Louis.

At the September 15th letting of the Missouri State Highway Dept., the following were among those awarded contracts:

Markham & Brown, Cape Girardeau, Mo., construction of concrete or clay lateral sewers in District No. 2-A, No. 2 and No. 9 in Cape Girardeau, Mo.

Asphalt Products Co., Cape Girardeau, Mo., improvement of Bessie St. from west end of Sunset Blvd. to east line of Caruthers Ave. with 6″ of stone base and 1½″ asphaltic concrete surfacing, including concrete curbs and gutters, in Cape Girardeau, Mo.

Grantwood Contracting Company, St. Louis, Mo., were low bidder at the September 12th letting of the U. S. Engineers covering asphalt surfacing of 76,500 sq. yds. of roads and 3900 sq. yds. of parking area at Jefferson Barracks, on their bid of $47,250.00.

Contracts were awarded to the following on bids opened September 5th by the Missouri State Highway Dept.:

Fred M. Clark & Son, Savannah, Mo., 4.729 miles of grading, bridges and surfacing in Clinton County—$32,563.00.

Concrete Materials & Construction Corp., Cedar Rapids, Iowa, 3.928 miles of grading, rolled stone base bituminous surfacing treatment in Harrison County—$75,473.00.

L. W. Riney, Hannibal, Mo., 1.500 miles of grading. and surfacing in Grundy County—$12,402.00.

O. W. Knutson, Kansas City, Mo., 2.936 miles of grading and surfacing in Sullivan County—$22,999.00.

Myron Baker, Independence, Iowa, 5.517 miles of grading and surfacing, Routes 15 and 16, in Scotland County—$16,695.00.

Bramhall Company, Carrollton, Ill., 6.592 miles of grading and surfacing in Carroll County—$11,994.00.

Bramhall Company, Carrollton, Ill., 6.859 miles of grading and crushed stone surfacing in Ray County—$18,519.00.

ODell & Riney, Hannibal, Mo., 0.071 miles of bridges at Boone Howard County line in Boone & Howard Counties—$78,-389.00.

L. L. Sharp, Springfield, Mo., 0.568 miles of grading, bridge and surfacing in Barry County—$18,843.00.

Neyer Construction Co., Billings, Mo., 0.161 miles of grading, bridge and 20′ concrete paving in Christian County—$35,576.00.

Fred Weber, Jr., St. Louis, Mo., 1.038 miles of grading and crushed aggregate surfacing through Hooker Hill in Pulaski County—$244,889.00.

E. H. Krehbiel, Kansas City, Mo., 0.023 miles of grading, bridge and concrete paving in Scott County—$14,844.00.

On bids taken by the U. S. Engineers

covering the construction of dikes, revetment and pilot canal near Glasgow, Missouri, following were low bidders:

Bilhorn, Bower & Peters, St. Louis, Mo., Schedule No. 1 (dikes and revetment) at $219,719.00.

Woods Bros., Omaha, Nebr., Schedule No. 2 (pilot canal) at $55,470.00.

MONTANA AREA

Reported by
L. E. JONES

Rogers Pass Job Awarded.—S. Birch Sons Construction Co., Great Falls, were awarded the construction of 1.3 miles of the Rogers Pass Road on September 19, at a bid price of $83,813. The award was made by the Bureau of Public Roads. Bids were received at the Missoula office.

George R. Melton Dies.—George R. Melton, of Dillon, and former Secretary of the Montana Highway Commission died on Sept. 19, at the age of 71. Mr. Melton served for 11 years, receiving his appointment by the late Governor S. V. Stewart.

Called to the Colors.—Scott P. Hart, Maintenance Engineer of the Montana State Highway Commission for the past ten years, has been ordered to report for active duty at Fort Ord, Calif. Hart, a major in field artillery, reported for his new duties on Sept. 26. No successor has yet been appointed by the Montana State Highway Commission to succeed Hart.

Highway Commissioners Appointed.—Governor Sam C. Ford of Montana on Sept. 25. appointed E. B. Coolidge, Great Falls, oilman and J. E. Foster, Harlowton, rancher and official of Mont. Woolgrowers Association, as two additional members of the Montana Highway Commission, in compliance with a law passed by the 1941 session of the Montana Legislature. The new law made it possible for the Governor to make these appointments after July 1, 1941. Under the 1941 session law, the state is composed of five districts, with a respective commissioner in charge, as follows: District No. 1—A. F. Winkler, Chairman, Kalespell; District No. 2—J. E. Foster, Harlowton; District No. 3—E. B. Coolidge, Great Falls; District No. 4—Walter Phillips, Phillips; and District No. 5—John Wheeler, Billings. As to the number of counties in each district, District No. 1—Eleven; No. 2—ten; No. 3—ten; No. 4—thirteen and No. 5—twelve counties.

Frank J. Haas, prominent Great Falls contractor took off last week for West Palm Beach, Florida by plane, on a business mission. He returned within a week.

Highway Association Meets. — The 26th annual convention of the Yellowstone Glacier Bee Line Highway Association held at Great Falls on Sept. 27, was well attended. Those elected to serve the organization for the ensuing year were: Paul Working, Wilsall, President; J. M. Garey, Kalispell, First Vice-Pres.; Earl Hall, Gardiner, Second Vice-Pres.; William L. Olson, Fairgeld, Sec.-Treas. Directors selected were: C. A. Lauer, Gardiner; Ed Parriot, Livingston; J. S. Code, White Sulphur Springs; Tony Faller, Nuhart; F. J. Gies, Monarch; N. H. Browning, Bret; Hugh Black, St. Mary's; J. N. Thelen, Great Falls, L. E. Taylor, Chateau; Fred Schoensegel, Fairfield; Joe Sherburne, Browning; Howard Hays, Glacier Park; J. W. Staley, Glacier Park Station; N. F. Gould, Kalispell and Joe Jaffee, Yellowstone National Park.

Speakers for the occasion were O. S. Warden and Dr. H. J. McGregor, both former chairmen of the Montana Highway Commission, Edwin Grafton, Helena, Public Relations Director of the Montana Highway Commission, and L. F. Martin, Engineer, Bureau of Public Roads, Missoula.

On Speaking Tour.—Don C. Young, manager of Milwaukee Railroad Gallatin Gateway Inn, is now on a tour, lecturing on travel and recreational advantages of Montana. He is scheduled to speak in 49 cities east of the Mississippi River from Maine to Florida and make 22 appearances on Columbia radio stations. He is well versed on the condition of Montana highway systems and routings to places of interest.

Number of Tourists Increases. — By the end of August, 1941, 114,776 tourist cars brought 355,805 visitors to the state of Montana, which is an increase of more than 3,300 cars and 10,000 tourists over the entire 1940 report.

BAD WEATHER FRIENDS
That Save Time, Money, Materials

When you have to cover up FAST to prevent damage to materials, tools or equipment — when bad weather threatens to slow up jobs — whenever you want quickly available, low-cost PROTECTION — use SISALKRAFT road blankets. They're absolutely waterproof — amazingly tough and durable — INEXPENSIVE. Available quickly from nearby distributors' stocks, in sizes for every need. Write for prices.

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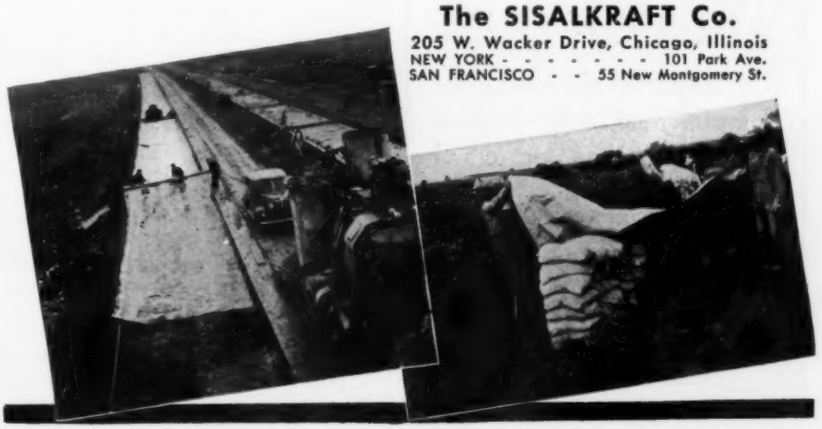

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Buy your snow removal equipment now, so you will have it when needed. Ross snow plows with their "Sno-Flo" mouldboards will move more snow with less power. They "always come back from a finished job ready to go out on another."

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Builders of Equipment for more than Fifty Years

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TYPE 80
AIR CONTROL

The leader of them ALL for smooth, fast and efficient shovel, dragline or crane operation.

We have a brand new catalog awaiting your request

THE OSGOOD CO
MARION OHIO

PITTSBURGH AREA

Reported by
JOHN W. PATTERSON

State of Pennsylvania.—The Pennsylvania Department of Highways will probably be first in the amount of work done throughout the country during the year of 1941. In the month of September they show major contracts let as follows:

Low Bidder	Location of Work	Lump Sum Bid
Earl M. Brown, Clearfield, Pa.	Bedford County	$ 75,700.00
Ed. H. Ellis, Westville, N. J.	North Hampton	177,823.00
Chas. H. Fry Construction Co., Erie, Pa.	Erie County	100,546.00
Chas. H. Fry Construction Co., Erie, Pa.	Erie County	35,040.00
Ryan Bros., Inc., Westfield, Pa.	Tioga County	303,104.00
S. T. Brotmarkle Construction Co., Cumberland, Md.	Cambria County	558,110.00
F. D. Kessler, Northumberland, Pa.	Tioga County	261,273.00
Harvey & Flory Co., Stroudsburg, Pa.	Tioga County	61,101.00
Geo. S. Mellert Widner Co., Medina, Ohio	Mercer County	150,499.00
Joseph Banks Construction Co., Wilkes-Barre, Pa.	Lancaster County	180,955.00
A. B. Cole, Meshoppen, Pa.	Bradford County	160,745.00
Trimpey Bros., Middleburg, Pa.	Wayne County	290,374.00
Allegheny Asphalt & Paving Co.	Allegheny County	37,882.00
Putman & Greene, Inc., Ft. Wayne, Ind.	Cameron County	227,372.00
Meade Construction Co., Pittsburgh, Pa.	Fayette County	140,144.00
Baldwin Bros. Paving Co., Cleveland, O.	Clarion County	207,741.00
Rosser Construction Co., Wilkes-Barre, Pa.	Wayne County	120,518.00
Union Paving Co., Philadelphia, Pa.	Delaware County	68,281.00
Chas. Riebe, Lansford, Pa.	Montgomery County	109,822.00
Laub & Collins, Wilkinsburg, Pa.	Somerset County	320,601.00
Joseph Banks Construction Co., Wilkes-Barre, Pa.	Carbon County	248,345.00
Ben Ferari, Latrobe, Pa.	Armstrong County	228,326.00
Walker Bros., Chambersburg, Pa.	Cumberland County	234,174.00
Frank O. Patterson, Donora, Pa.	Washington County	26,358.00
A. W. Hinaman, Williamsport, Pa.	Bradford County	277,216.00
D. E. Smith, Mifflin, Penna.	Center County	187,299.00

The largest project for which bids were asked in Pennsylvania during September covered reinforced concrete pavement together with four reinforced concrete structures in Butler County. Bids were taken on three schedules with the lump sum bids as follows:

SCHEDULE NO. 1

Ralph Myers Const. Co., Salem, Indiana	$649,517.51
Central Penna. Quarry, Stripping & Const. Co., Hazleton, Pa.	645,287.89
Hindman Brothers Const. Co., Pittsburgh, Pa.	674,409.79
M. Bennett & Sons, Indiana. Pa.	694,807.52
Harrison Const. Co., Pittsburgh, Pa.	712,073.13
Laub & Collins, Wilkinsburg, Pa.	735,184.57
Frank Donatelli & Co., Pittsburgh, Pa.	789,448.54
McCrady Const. Co., Pittsburgh, Pa.	851,487.10
Frank Mashuda Co., Milwaukee, Wis.	888,791.22

SCHEDULE NO. 2

Ralph Myers Const. Co., Salem, Indiana	$466,440.51
Harrison Const. Co., Pittsburgh, Penna.	531,327.47
Baldwin Bros. Paving Co., Cleveland, Ohio	546,410.33
B. Ferari, Latrobe, Penn.	637,880.49
Frank Donatelli & Co., Pittsburgh, Penna.	694,565.41

SCHEDULE NO. 3

Ralph Myers Const. Co., Salem, Ind.	$1,115 958.02
M. Bennett & Sons, Indiana, Pa.	1,205,065.47
A. Guthrie Co., St. Paul, Minn.	1,444,383.78

On September 26th bids will be asked on eight more large projects covering road construction and it is expected all of the work will be awarded and under way by the latter part of October.

Allegheny County Airport.—As stated in previous issues the Federal government has approved a $2,600,000 expenditure for a major airport in Allegheny County. The Commissioners of Allegheny County have approved the expenditure and the site was expected to be selected early in October. The location that seems to be most favored is the John A. Bell Farm near Coraopolis Heights, Allegheny County. Should the Bell property be selected we understand there will be at least 1,000,000 yards of excavation and embankment in connection with the project and the work will probably be ready for bids the latter part of October. We understand that the work will be performed under the supervision of U. S. Engineers located in the City of Pittsburgh.

Hats off to Laub & Collins who are just finishing a major road project on the William Penn Highway near Pittsburgh, Penna., and are low bidders on another State Highway Department job in Somerset County at a lump sum bid of $320,601. Among the major items are 74,673 cu. yds. of excavation and 49,733 sq. yds. of concrete pavement. Laub & Collins are also finishing up a large airport job at Johns-

town, Pa., where they have moved several hundred thousand yards of excavation. This Company have certainly made great progress since they have organized within the last few years. Messrs. Collins, Laub and Troll are all expert construction men, and their performance during this past season rates them well among the top flight contractors in the eastern part of the country.

MICHIGAN AREA

Reported by

J. M. TELFORD

Road Commissioners Elect Officers.—Elmer J. Bitt, member of the Iosco County Road Commission, was elected president of the Northern Michigan County Road Commissioners Association at its annual convention in Cheboygan Sept. 18-19. Mr. Britt succeeds Hiram H. Starmer of Petoskey. Other officers for the coming year are Duncan Morrison, Grand Traverse County, vice-president; B. D. Jeffs, Missaukee County, secretary (re-elected), and N. E. Wicks, Lake County, treasurer (re-elected).

A resolution proposing an increase from $50 to $100 in weight and gasoline tax returns for the maintenance of former township roads per mile per year was adopted. Defense problems occupied much of the attention of speakers at the convention. Priorities in particular were explained to the delegates.

The 1942 convention will be held in Traverse City.

Paving Starts.—First actual paving work on the Davison Limited Highway project of the Wayne County Road Commission was started early in September by the Weir Construction Company. The completed project will carry traffic completely through Highland Park without grade intersections. The first pavement is the south service drive, which now is well under way. Contracts for several bridge structures to carry traffic over the new highway are to be awarded in October.

Bridge Gets Preference Rating.—The first State Highway Department construction project to receive a preference rating order from the Office of Production Management was a bridge carrying US-31 over the Black River on a relocation around South Haven. Walter Toebe & Company of Lansing has the contract for the job, which was given an A-2 rating. Several other preference ratings since have been received for state highway projects.

Installs New Plant.—Ray Sablain, Lansing contractor and gravel producer, has installed a new complete Model 125 Austin-Western gravel washing plant at his new pit just northwest of Lansing.

Speed Work on Airport Project.—Work is being rushed on the huge concrete runway project at the new Ford bomber plant airport just east of Ypsilanti. Several pavers already are at work on the project, which is the equivalent of about 70 miles of standard concrete pavement. The contract is held by Julius Porath and Son of Detroit, and Lewis & Frisinger Company of Ann Arbor and E. B. Schwaderer of Cass City are doing a share of the paving.

Low Bids and Awards.—Contract for paving sections of 16 streets was awarded by the Berrien Springs Council to John Yerington of Benton Harbor at $45,528.05.

Low bids on 20 projects were opened September 24 by the State Highway Department. Included in the projects were 68 miles of trunkline road improvements, two large bridges and a grade separation. W. J. Meagher & Son of Bay City submitted the low bid of $588,473.83 for a double leaf bascule bridge on US-31 in Cheboygan, the largest single project. The other bridge job, a 5-span structure on relocated US12 in Mackinac county, brought a low bid of $181,990.10 from the H. C. Mahon Company of Detroit. Among the highway projects were 8.874 miles of resurfacing between Marshall and Battle Creek, on which the Detroit Asphalt Paving Company was low at $104,068.61; 1.367 miles of grading and concrete on M-21 in and west of Lapeer, on which The Thomas Currie Company of Detroit bid $105,357.46; more than five miles of grading and concrete pavement on US-31 northeast of Manistee, on which Claude M. Loomis of Grand Rapids bid $233,907.61; and about four miles of grading and concrete in Tuscola county, on which the $137,063.74 bid of E. E. Schwaderer of Cass City was low.

AASHO Meet in Detroit.—The Michigan State Highway Department acted as host to the annual convention of the American Association of State Highway Officials, which was held in Detroit the week of September 29. Following the association's program, a caravan tour for the delegates was arranged by the department.

Miscellaneous News

A priority rating of A-2 has been granted by the Priorities Committee, Army and Navy Munitions Board, "for improvement of the levee system constituting the major part of the project for flood control of the Lower Mississippi River," it was announced officially by Office of Chief of Engineers.

The blanket rating covers "replacement parts and minor materials necessary to keep the operation going." Previously an A-3 rating had been granted for the maintenance of Mississippi River navigation.

Contractors requiring repair parts and materials on flood control jobs in the Memphis, Vicksburg and New Orleans Districts are to make their needs known to the District Engineer under whom they are working. Certificates will be issued by the District Engineer promptly as possible.

The A-2 rating applies to all outsatnding flood control contracts and to all contracts to be awarded this year in the lower Mississippi Valley. The priority ruling will be incorporated in future specifications.

Completion of the new Willow Cloverleaf south of Cleveland marked another milestone in Ohio's highway safety program. Modern construction methods were used throughout, including steel Monotubes for the installation of more than 800 cast-in-place concrete piles.

The list of prominent projects using Monotubes is mounting daily. The reason—Monotubes offer the simplest and speediest method of producing dependable cast-in-place concrete piles ever devised. These light weight tapered steel casings cut handling time and costs. Driving time is reduced because Monotubes require no core or mandrel. There's no cumbersome driving rig to slow you down, either—any crawler crane equipped with standard leads and hammer does an efficient job.

There's a size and gauge of Monotube to meet every soil condition. Write for Catalog No. 68A.

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CRUSHING, SCREENING and WASHING UNITS
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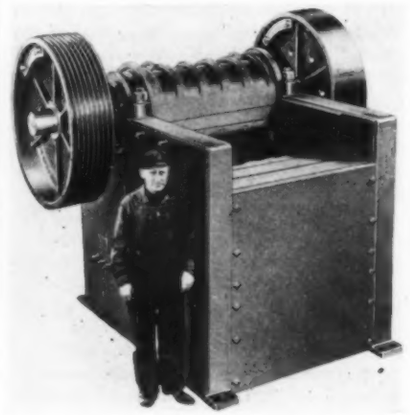
With SILVER KING
Do fast, economical mowing on the level or in the rough with Silver King, the mowing unit that's ENGINEERED for the job. Write for details.
THE FATE-ROOT-HEATH CO.
Plymouth, Ohio
The Favorite Mowing Unit for City, County and State Highway Departments

IN DOWNTOWN CHICAGO
Write for map

NEW EQUIPMENT and MATERIALS

Pioneer Rock Crushers

The new jaw crusher just put on the market by the Pioneer Engineering Works of Minneapolis will merit careful study. The size is notable, 30 in. by 42 in., of a very pleasing design, streamlined with smooth surface, and welded steel base. The overhead eccentric is new for large crushers, with SKF self-aligning spherical roller

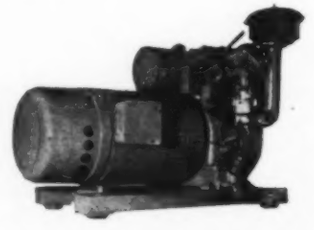


bearings, manganese jaws, worm and gear adjusting mechanism, together with the overhead eccentric as stated above.

The use of modern materials together with the special design and construction, saves more than 50 percent in the weight of the crusher, which is an important item when such equipment has to be moved, and a great economy when the contractor is buying such a piece of equipment.

New 11-Volt A.C. Light and Power Plants

The Kato Engineering Company, 56 Elm St., Mankato, Minnesota, has announced a new line of light and power plants. The series includes Models 14A, 600 watt; 26A, 1000 watts; 28A, 1500 watts and Model 30A, 2000 watts. Generators are of the self-excited, single phase type, generating 110-volts, 60-cycle A.C. 1800 r.p.m. A source



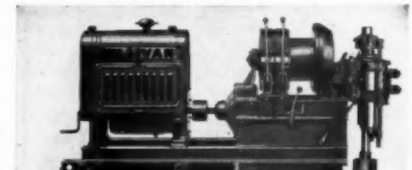
of D.C. may be drawn from the D.C. terminals when plant isn't carrying full A.C. load. This source of D.C. is furnished at a desirable and usable voltage, 12-volts or 32-volts. A.C. and D.C. brushes are easily accessible. Power is supplied by Briggs & Stratton, 4 cycle, single cylinder, air-cooled engines. Available with remote control or full automatic control if desired.

Welding Rod for Equipment Repairs

Tournaweld, developed and manufactured in the LeTourneau plant at Peoria, Ill., expressly for the various welding applications used in the manufacture of LeTourneau equipment, is now available for general maintenance work from the "Caterpillar"-LeTourneau distributor organization. Tournaweld electrodes have been thoroughly proved by almost two years of use in LeTourneau plants, during which time the company has used more than 4,000,000 lb. for welding mild steels and special analysis steels used in the manufacture of LeTourneau products. Tournaweld is available in the following sizes: 5/16 in., 9/32 in., ¼ in., 7/32 in., 3/16 in., 5/32 in. and ⅛ in. Additional information on Tournaweld can be obtained from LeTourneau-"Caterpillar" distributors or by writing R. G. LeTourneau, Inc., Peoria, Ill.

New Core Drill

A new heavy duty core drill—the No. 22-HD—has been brought out by the Sullivan Machinery Co., Michigan City, Ind. It is adaptable for coal and mineral prospecting, oil field service or testing foundations for heavy construction. This modern drill is built for surface drilling under the toughest of operating conditions, and is conservatively rated at 1750 ft. capacity with "E" rods. The No. 22-HD core drill is a direct drive machine with power unit connected to the drilling head through the



New Sullivan Core Drill

4-speed automotive type transmission by means of a clutch. The built-in clutch allows the use of any power unit having a stub shaft (electric, gasoline or diesel) if operating characteristics are suitable. Controls and conveniently grouped, all gears are enclosed, and a hand-lever safety clutch permits the runner to stop the rotation of the beveled drive gear when the swivelhead is open while running or pulling rods. The swivelhead, large hoisting drum, transmission, clutch and power unit are mounted on rigid skid base. The unit can be quickly dismantled into four main parts for mule-back transportation.

Wire Rope for Cable-Operated Tractor-Drawn Equipment

Tournarope, a 6 x 9 filler wire right lay wire rope with an independent wire rope center and an identifying galvanized core strand, manufactured by R. G. LeTourneau,

Inc., especially for cable-operated, tractor-drawn equipment, is now available through the "Caterpillar"-LeTourneau distributor organization. Tournarope is made of 199 fine steel wires, drawn to LeTourneau's own specifications, each wire bathed in oil as it goes into the strand die. LeTourneau began the manufacture of Tournarope a year ago. Since then all LeTourneau equipment shipped from the factory has been equipped with this new, specially made wire rope. As a result, Tournarope has been thoroughly tested by hard usage on the country's biggest and toughest jobs. Tournarope comes in the six following sizes: 3/8 in., 7/16 in., 9/16 in., 5/8 in., 3/4 in., and 7/8 in. For more complete information about Tournarope see your LeTourneau-"Caterpillar" distributor or write R. G. LeTourneau, Inc., Peoria, Ill.

New Lima Type 603

The Lima Type 603 is a combination shovel, dragline and crane. When used as a shovel, it is equipped with a 21'-0" boom, 17'-0" dipper handle and a 1½ yard dipper. As a crane, it has a maximum lifting capacity of 25 tons. Dragline capacity is variable, depending on the nature of the work. The shovel boom is the box type design, electrically welded throughout. The dipper handle is of the same modern construction. The Type 603 is available with either a gas, Diesel, oil or electric power unit.

Mowing Machine Announced

A new mowing machine, specially constructed to serve the needs of highway maintenance crews, has been perfected by the Ferguson-Sherman Manufacturing Corporation of Dearborn, Michigan.

Built for the Ford tractor and operated on the Ferguson system principle, the mower has the benefits of the specially designed Ferguson hydraulic finger-tip control which permits the operator to raise or lower the cutter bar to any position without leaving the driver's seat.

The mower is adaptable to any slope. It can be raised or lowered (up to 9½ inches) and still permit the sickle to operate with the cutter bar in any position from 45 degrees below horizontal to vertical.

WITH THE MANUFACTURERS

Charles H. Roberts Dies

Charles H. Roberts, treasurer of Johns-Manville Corporation, died Wednesday morning, September 10th, at Doctors Hospital where he had been confined since August 20th for treatment of a heart ailment. Mr. Roberts was 51 years old and lived in Scarsdale, N. Y. Born on a farm near Doylestown in Bucks county, Pennsylvania, on May 8, 1890, Mr. Roberts received his secondary education in Trenton, N. J., and attended the Wharton School of Finance of the University of Pennsylvania until 1907, when he began his business career with J. A. Roeblings Sons Co. as head of their cost department. Later he served in various capacities in the financial departments of the Mercer Automobile Co., Hess-Bright Manufacturing Co., U. S. Rubber Co., Splitdorf Electrical Co., and Julius Kayser & Co. before joining Johns-Manville in 1928 as assistant general auditor. In that same year he was made general auditor. In 1937 he became comptroller and the following year was appointed treasurer. Mr. Roberts was a member of the Westchester Hills Golf Club at White Plains, N. Y., Cobleigh Club, Inc., at Rye, N. Y., and the Controllers Institute of America.

Chicago Pneumatic Tool Co. Acquires Plant of Champlain Corp.

Further expansion in the aviation industry by the Chicago Pneumatic Tool Co. is marked by the acquisition of the Garfield, N. J., plant of the Champlain Corporation. The Chicago Pneumatic Tool Co. will employ the full facilities of the New Jersey plant for the manufacture of hydraulic equipment used on military and naval planes of all types. The factory, a modern building of over 90,000 sq. ft., is being adapted to the new production as rapidly as possible. The program will require substantial additions in both equipment and personnel. Champlain Corporation, a subsidiary of the Inter-Chemical Corporation, will continue its business of manufacture and sale of printing presses and related equipment. Its production activities will be transferred to a plant of the Inter-Chemical Corp., located in New York City.

E. B. Cape Appointed District Engineer at Asphalt Institute

W. R. Macatee, Managing Director of the Asphalt Institute, has anounced the appointment of E. B. Cape as district manager, for the territory comprising Texas, Oklahoma and Arkansas, with office in the

WELDED
ROLLED STEEL CONSTRUCTION for GREATER STRENGTH and SPEED

LOWER HEAD ROOM
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Welded Construction insures longer wear—less breakage. Cutting down unnecessary weight means faster work—more yardage. Williams sheave arrangement keeps leads straight, less friction and fraying—longer cable life. Sheaves protected against contact with bucket load, open end sheave block prevents clogging.

Bulletin describing each type of Williams Bucket FREE on request.

Distributors in all parts of the country.

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CAST WEDGE BARS

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STULZ-SICKLES CO.
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MULTI FOOTE
CONCRETE PAVERS
Single drum 27-E and 34-E models. Also tower and inclined boom pavers. Catalogs on request.
ADNUN
BLACK TOP PAVERS
For Black Top paving and rock spreading. Only machine with continuous course correction.
Ask for Catalog.
THE FOOTE COMPANY, INC.
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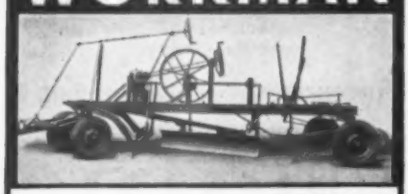


For Better Roads, put a WORKMAN Machine on the job. 3 sizes:
THE GENERAL • THE SUPER
THE MASTER
YORK MODERN CORPORATION
UNADILLA, NEW YORK

Littlefield Building, Austin. Tex. Mr. Cape's engineering training began with the field crews of the Texas Power and Light Co. while attending A. & M. College of Texas. For the past 12 years he has been employed by the Texas Highway Department,—for six years with headquarters at Bryan and Lufkin in the south central and eastern portions of the state, as assistant resident and project engineer on all types of construction work.

In 1935, he was transferred to the Austin office where he served first as assistant construction engineer and then, until his Institute appointment, as materials and tests engineer for the department.

New Distributors for Le Roi

Le Roi Co., Milwaukee, Wis., manufacturers of a complete line of portable air compressors, announce the appointment of the following dealers: The W. T. Walsh Equipment Co., 3088 W. 106th St., Cleveland, O.; Wylie-Stewart Company, 1400-1426 Exchange Ave., Oklahoma City, Okla.; H. W. Findley Company, No. 2 Glass Ave., Carnegie, Penn.; Grafflin S. Prather, 7 Canal St., Red Bank, N. J. These new distributors will handle the line of air compressors in and around the cities in which they are located.

B. F. Devine Promoted by Chain Belt

G. K. Viall, vice-president of Chain Belt Co. of Milwaukee, Wis., has been appointed as head of a new division of research and development now being organized by the company. Mr. Viall has been connected with Chain Belt Co. since 1921 in various capacities, including chief engineer chain division assistant to the president and works manager. In assuming his new position, he will also retain his position as vice-president in charge of the construction machinery division. B. F. Devine, who joined the Chain Belt organization in 1909, has been promoted from sales manager of the construction machinery division to the position of manager of the construction machinery division. Mr. Devine has served in the purchasing department, the engineering sales department and later as assistant sales manager of the construction machinery division. In his new position he also will supervise the management of sales of this division.

B. F. Devine

New Open-Hearth Furnace for Wisconsin Steel Works

First steel has just been poured from a new 150-ton open-hearth furnace at the Wisconsin Steel Works of the International Harvester Co., the first addition to the open-hearth steel-making capacity of the Chicago district as the result of new construction, since the advent of the national defense program. The tapping of the new furnace, finished 45 days ahead of schedule, was witnessed by a group of newspaper men and officials of the company. The open-hearth furnace just tapped is one of two new ones built by the Harvester Company to increase the steel ingot capacity of its Wisconsin Steel Works. The two new furnaces will add approximately 160,000 tons of steel to the annual capacity of the Chicago steel district, and will increase the annual capacity of the Wisconsin Steel Works to approximately 860,000 net tons of ingots. In addition to the two new open-hearths, a 220-ton crane, a charging machine and a 2-hole soaking pit were constructed as part of the same expansion program. The total cost of the construction job was approximately $1,500.000. The two new furnaces at Wisconsin Steel were among the first to be authorized after the needs of the national defense program had caused the government to ask an expansion of the nation's steel-making capacity. They are also among the first to be completed, the initial heat being poured only a few hours after the last of the construction men had finished their work on the erection of the new building.

Harold Smith Promoted by Buda Co.

Harold G. Smith, former chief engineer of the automotive division of The Buda Co. at Harvey, Ill., has been promoted to executive engineer of Buda in charge of all engineering of automotive, and marine, and industrial engine and radial diesel engine division. Mr. Smith is well known in the engineering field nationally, is a member of the S.A.E., a member of S.A.M.E., a member of Olympia Field Country Club, and is on the Engine Standards Committee of the Society of Automotive Engineers.

H. G. Smith

Kadco Corporation Joins Complete Machinery & Equipment Co.

Kadco Corporation of New York City, pioneer manufacturer of dust control machinery for rock drilling, mine, and quarry work, has been acquired by Complete Machinery & Equipment Co., Inc., of Long Island City. Henceforth all manufacturing, sales and service activities will be conducted at the latter's plant. The new address for Kadco Corporation is 36-40 Eleventh St., Long Island City, N. Y.

To Restyle F W D Trucks

The Four Wheel Drive Auto Co. of Clintonville, Wis., has announced the commissioning of Brooks Stevens, prominent Milwaukee industrial designer, to restyle and streamline FWD trucks for future commercial production. Busily engaged at present in filling delivery demands of both large commercial and defense orders, the FWD Company officials are looking forward to the post war period when peace will bring the opportunity for commercial expansion and

Brooks Stevens

improvement. Preparations on the eventual new line of FWD trucks which will impart a closer resemblance between the various models ranging in size from 1½ ton to 25 ton capacity have already begun and are expected to extend over a possible one year period. One of the features of the new styling program will be the interchangeability of body parts making faster production possible.

Louis B. Neumiller Succeeds B. C. Heacock

Louis B. Neumiller, who began his association with Caterpillar Tractor Co. of Peoria, Illinois, 26 years ago as a stenographer and blue print clerk in the engineering department, has been elected president of the company by the Board of Directors.

Mr. Neumiller succeeds B. C. Heacock, president since 1930, who becomes chairman of the Executive Committee.

L. B. Neumiller

The new president of Caterpillar Tractor Co. is a native peorian, educated in his city's schools. The story of his rapid ascent in the company ranks is a shining example of the American way of life and the opportunities it offers one with ability, ambition and courage.

Mr. Heacock, who becomes chairman of the Executive Committee, succeeds R. C. Force, who resigned as committee head, but remains a member of the board. Mr. Heacock will have headquarters in Peoria, although at present his time and attention are occupied in Washington, D. C., where he went last spring on a leave of absence to serve as special assistant to Under-Secretary of War Robert Patterson.

Myron Powers Appointed Manager of Purchases for Chicago Pneumatic

Chicago Pneumatic Tool Co. has announced the appointment of Myron Powers as manager of purchases with headquarters at the general offices, 6 East 44th St., New York, effective June 1st. Mr. Powers was formerly in charge of purchases at the Cleveland plant.

J. L. Lynch New Representative for Morris Machine Works

Morris Machine Works, Baldwinsville, N. Y., manufacturers of centrifugal pumps, hydraulic dredges and steam engines, has announced the appointment of L. J. Lynch as their new representative in the Detroit district. Mr. Lynch is located at 403 Kales Building, Detroit.

Fabick Tractor Co. Appointed Distributor for Sullivan

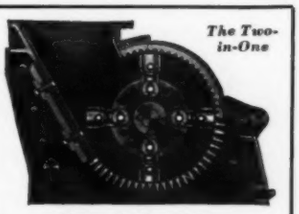
The John Fabick Tractor Co., Gravois and Iowa Aves., St. Louis, Mo., has been

Serving America in Road Construction

The GRUENDLER Two-in-One Hammer Crusher

Has a crushing range from 2 1/2 inch aggregate to as fine as agricultural lime dust.

The Popular Portable Two-in-One Hammer Crusher for farm-to-market road work.



The Two-in-One

Cross Section View
STATIONARY HAMMER CRUSHER from 1 ton per hour to 500 tons per hour capacity

The above portable unit showing mounting on heavy steel trucks with folding bucket elevator, ready for traveling—the most durable design and very popular with contractors when operating from quarry to quarry.

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Plants: Wyandotte, Michigan

appointed distributor for Sullivan Machinery Co., through Southeastern Missouri and Southern Illinois. They will act as sole distributor for the complete line of Sullivan contractors' equipment including air compressors, rock drills and hoists.

NEW TRADE LITERATURE

Steel Street Forms.—Blaw-Knox Co., Pittsburgh, Pa., has issued a new bulletin, No. 1828, on steel street forms. It presents diagrammatic sketches and photographs of form installations for concrete curb, curb and gutter, integral curb, sidewalks, gutters, flexible and fixed radium forms, etc. Optional form designs are presented for each type of work.

Link-Belt Speeder Shovel.—A new 4-page Folder No. 1914 illustrating and describing its ½-yard Model LS-50 crawler shovel-dragline-crane, has just been published by Link-Belt Speeder Corp., 301 West Pershing Road, Chicago. The folder particularly covers some of the new design features of this excavator. Clearances, dimensions, lifting capacities, and brief specifications, are given.

Calcium Chloride for Airport Runways.—Bulletin No. 28 of the Calcium Chloride Association treats of soil-aggregate stabilization, dust laying, base stabilization and surface consolidation. The 24 pages cover eleven features of the above problems, and are well illustrated with views, and several pages of diagrams, in making clear this advance in road building. The text covers fully the use of calcium chloride for military roads and airport runways. The last page lists other bulletins issued by the Association.

Wire Rope for Construction Equipment.—The many uses of wire rope are described in a new 20-page booklet issued by the Hazard Wire Rope Division of American Chain and Cable Co., Wilkes-Barre, Pa. The various types of cable are shown in section, and a 2-page table gives recommendations as to the type of cable to use for over 20 classes of plant.

Defense Vehicles.—The Marmon-Herrington Co. of Indianapolis have just published a pamphlet of Vehicles for National Defense, comprising 8 pages, with a view of the plant, and curves showing output, with interior views of the shops. There are illustrations of cavalry scout cars; machine gun trucks; ambulances; wrecking trucks; hole boring trucks; balloon winch trucks; speedy ones for "crashes," with several types of tanks and tractors; as well as trailers. Many of the pictures show equipment in service or under field test.

Safety Shoes for Workers.—The Lehigh Safety Shoe Co., Inc., of Allentown, Pa., are sending out a 12-page booklet of "Safety Shoes and Boots" for workmen engaged in hazardous work. The methods of manufacture are described, with illustrations of design of details. There are numerous illustrations of work shoes, safety oxfords; oil fighters; and high boots. Full instructions are included as to measurements needed to obtain proper sizes.

CLEARING HOUSE

USED EQUIPMENT FOR SALE

1—"Caterpillar" Diesel Engine D6100, 47 H.P. open clutch, outboard bearing $1,350.00
2—Jaeger 4" Centrifugal Self-priming Pumps, powered by radiator cooled gasoline engine and mounted on 2 steel wheels. Each 375.00
2—Sterling 4" Centrifugal Self-priming Pumps, powered by 4 cylinder gasoline engines, mounted on 2 steel wheels. Each 375.00
1—Burch Portable Belt Conveyor 25' boom, 24" wide belt, powered by Leroi Engine on steel wheels 600.00
1—LeTourneau Model U-9 Scraper in A-1 condition 2,975.00
1—Gruendler Model No. 6 Lime Pulverizer 15 to 18 T.P.H., used only one mo. 2,200.00
1—Baker Model 1A Automatic Lift Rooter, 5 standards. Looks like new 450.00
1—New LeTourneau Model FP Scraper on six 18x24 tires. Only used two weeks...SAVE 10% ON THIS
1—Allis Chalmers, 45 H.P. Power Unit, equipped for kerosene operation 495.00
1—Barber Greene Model 54 Utility Ditcher, 12" buckets. Good condition 1,500.00
1—International T35 Tractor, equipped with crankcase guard, radiator guard, front pull hook. Rebuilt and in good condition. 1,500.00
1—Gardner-Denver Single Stage Compressor, powered by Buda Engine, 220' displacement..... 950.00
1—New Gardner-Denver 2 stage Compressor, Diesel engine driven, 210' actual air, used only 200 hours 4,250.00
1—Air cooled Compressor 210' actual air, electric driven by 50 H.P. General Electric Motor.. 1,495.00
2—LaPlant-Choate Crawler Wagons, 10 yd. capacity, hydraulic control, side dump, rock type with tractor pump. Each..... 1,850.00
1—24x16 Roll Crusher. Like new.. 875.00
1—10x30 Wheeling Crusher roller bearing, jaw type, first-class condition 1,675.00
1—Sauerman 5-ton tautline Cableway with cable sheaves and clips for 540' working span. Will furnish with or without hoist .....Bargain price

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HEAVY GRADING EQUIPMENT
1—Model KO 54 AC speed patrol grader.
1—Model 10-K Ryan pull grader.
1—No. 14 AC power controlled pull grader.
1—10-ton Huber roller, gas engine power.
1—10-ton Buffalo steam roller.
1—4 to 5 yard Ateco hydraulic scraper.
1—Model L tractor.
1—Model LO Allis-Chalmers tractor.
1—Model K Allis-Chalmers tractor with dozer.
USED TRACTOR PARTS
Large assortment parts for Models L and LO Allis-Chalmers and 60 and 65 Caterpillar, including transmissions, gears, sprockets and motors.
Write for our complete used equipment list
GENERAL MACHINERY COMPANY
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Rebuilt for Immediate Delivery
2 Yard Crane
70' Boom—Diesel Engine.
2 years old—Factory Rebuilt.
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1—10 S Jaeger Concrete Mixer
1—27 E Foote Paving Mixer
1—10 Ton Buffalo Springfield Tandem Roller
1—8 Ton Buffalo Springfield Tandem Roller
FOR SALE
1—No. 1 Allis Chalmers Pulverator
1—30 ft. 16" Electric Northern Belt Conveyor
1—Electric Motor driven Sack Cleaner
1—21" Buffalo Drill Press
1—Illinois Machine & Mfg. Co. Grinder
1—4 ft. long, 30" dia., Screen
1—Abell-Howe 17 ft. span 5 ton hand operated Crane
1—Batch Hopper and Scale for 125 ton bin
200 Ft. 2" Hose
1—30 ton Fruehauf Trailer, platform 10 ft. Wide by 22 ft. long—length overall 31½ Ft.
THE BARBER EQUIPMENT CO.
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We will be glad to figure on equipment and supplies for any job.

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Two Driers—22 ft. long, 66" Diameter.
One—5 ton Shop Crane 7 ft. Span, hand operated.
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CLEARING HOUSE

EQUIPMENT FOR SALE

TRACTORS

Cletrac "DDH" Hillside Model Tractor No. 1-L-3082 with Hercules Diesel 61 H.P. motor, 18" tracks, overhauled and in very good condition.
Cat. "60" Tractor in operating condition.

EARTH HANDLING EQUIPMENT

Austin-Western 5 yard cable scraper, good condition.
Austin-Western winch for above scraper, to fit any standard crawler tractor.
Ateco 5 yard scraper with hydraulic attachments for Cat. "60". Good condition.
Ball Wagon, 3 yard, working condition.
Page ½ yard dragline bucket complete, reconditioned and in excellent condition. Painted red.
Austin Western 30 Ft. crane boom for Badger Shovel with fairleads in good condition. Painted red.

GRADERS

Ryan 12 Ft. Grader, power controlled, leaning frame, steel tired roller bearing wheels, in operating condition.
Adams 8 ft. Grader with good solid rubber tires, roller bearing wheels, painted yellow. Good condition.

CRUSHING EQUIPMENT

Simplicity 2 deck screen, 3' x 6' without screen cloth, painted gray, excellent condition.
Niagara 2 deck 3' x 8' screen with 1" and 1½" cloth on top deck, ¼" screen cloth on bottom deck. Rebuilt with new bearings. Excellent condition.
Austin-Western 32" x 14' revolving screen with 4 ft. sand jacket. Will be rebuilt and sold with guarantee.
Manistee 6" centrifugal pump, high head, triple stage, capacity 600 gal. per minute at 150 ft. head. Mounted on steel skids with factory rebuilt Hercules 50 H.P. motor, 4 cyl. Painted red and in excellent condition.
Waukesha 4 cyl. 40 H. P. Power unit complete with clutch, 10" pulley with Gates No. 210-C "V" belts. Painted yellow, very good condition.
LeRoi 4 cyl. Power unit on skids. Motor No. 80095, with 2 to 1 reduction gear and clutch, hood sides. No pulley. Painted yellow. In new condition.
No. 105 Austin Gyratory Crusher with back gear on steel tired trucks. Excellent condition.

TELFORD EQUIPMENT CO.
735 E. Kalamazoo St., Lansing, Michigan

FOR SALE

CRANE BOOM, 40', for Model 2 & 3 Northwest machines.
BUCKET, dragline, ¾ yd. Page Automatic.
BUCKET, dragline, 1 yd. Page Type M.
BUCKET, dragline, 2 yd. Omaha heavy duty.
DRILL SHARPENER, Sullivan Class "C".
GRADER, Adams No. 12, leaning wheel.
GRADER, Caterpillar 10', pull type, hand control, leaning wheel.
RE-TREAD MIXER, Parson Turbo.
PAVER, 13E Koehring (½) yd. on full crawlers, 20 ft. boom and bucket.
PILE HAMMER, No. 3 Vulcan.
SCALE, Winslow 12 ton truck scale 18' x 9'.
SHOVEL, ⅜ yd. Insley (half swing).
SHOVEL ATTACHMENT for Model 4 and 5 Northwest machines.
SCREENING & LOADING PLANT, Cedar Rapids portable gravel and sand loading plant, OPO type, with Waukesha gasoline engine, screens, feed and delivery conveyors.
TRACTOR, Caterpillar "30" with bulldozer.
TRENCH MACHINE, Austin Model 150.
WAGON DRILLS, Cleveland DR-8 (latest model) with D-14 DR drifters.

Offered subject to prior disposition.

O. B. AVERY COMPANY
1325 Macklind Ave. St. Louis, Mo.

SPECIAL

1—Austin Western 15x20 Roller Bearing Jaw Crusher No. 2600.
Price $1,500.00

JOHN W. PATTERSON CO.
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18.00x24 down to wheelbarrow size. Full line of new and used tires.

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Immediate delivery on complete unit for casting 108" diameter reinforced concrete culvert—Good as new.

ERIE FORGE & STEEL CO.
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30 x 10 Portable **CRUSHING PLANT**
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1 Ton Cap. **ASPHALT PLANT**
3—800 x 1,000 Gal. **DISTRIBUTORS**
18 in. x 200 ft. **BELT CONVEYOR**
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½ yd. Owen **CLAMSHELL**
10 Ton Tandem **ROLLER**
2—1,000 ft. **DIESEL AIR COMPRESSORS**
30—1½ yd. and 3 yd. **DUMP CARS**
6 **ORANGE PEELS**—6 to 27 ft.
100 H.P. Lambert three drum **ELEC. HOIST**
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2—2½ and 3 ton tandem gas **ROLLERS**

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FOR SALE—1 Model L 4 Nelson Bucket Loader, mounted on caterpillar treads, purchased new September, 1940. A Bargain. Located in Kansas. **Address Box 437, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

FOR SALE—1 Model 24B Barber-Greene Flight Coal Loader, mounted on caterpillar treads, with shaker screen. Equipped with four cylinder gasoline engine. Located in western Missouri. **Address Box 438, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

FOR SALE—1—9" x 36" Universal Jaw Crusher, mounted on 4 wheel steel truck with bucket elevator. A real bargain. Located in southern Missouri. **Address Box 439, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

FOR SALE—1—6 x 6½ Ingersoll Rand Portable Compressor with 4 cylinder gasoline engine, mounted on 4 solid tired wheel trailer, rated capacity 210'. Located southern Missouri. **Address Box 440, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

Advertising Manager

now and for past 15 years manager of advertising department of $13,000,000 manufacturer of machinery and tools, is available for similar position preferably in New York City or nearby locality. Has complete charge of trade paper advertising, preparation and production of catalogues, booklets, sales material, etc. Address Box 441, Roads and Streets, 330 So. Wells St., Chicago, Ill.

POSITION WANTED

POSITION WANTED—Construction Supt. Over 20 years experience in road building all types—both highway and city—grading, culverts, drainage, catch basins, manholes, curb, curb and gutter. Everything pertaining to road building construction. **Box 436, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

GENERAL MANAGER—Forceful, capable executive, twenty years experience in construction of all types roads, bridges, sewers, etc., seeks position as general manager for contracting firm. Expert in the preparation of bids, contracts, purchasing, organization and control of heavy construction projects. Ideal man for bank or heirs. Willing to work on percentage basis. Available on short notice, willing to go anywhere. **Box 435, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

POSITION WANTED—Experienced operator and service man on all types of road machinery. 16 years experience. Married with family. Draft exempt. Prefer work in Missouri but would go anywhere. Can furnish good references. **Box 434, Roads and Streets, 330 So. Wells St., Chicago, Ill.**

OPERATOR of Northwest shovel and dragline with seven years experience. Reliable, single, free to go anywhere. Age 28. Box 444, Roads and Streets, 330 S. Wells St., Chicago, Ill.

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The two air hose couplings described below, in addition to eliminating trouble and loss of time due to mislaid or worn-out washers, are designed for quick, easy connections, without excessive hammering on the wing nut.

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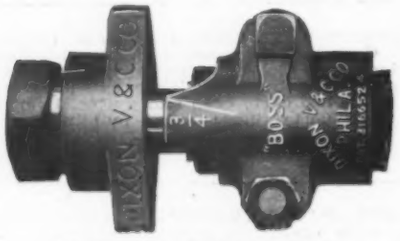
GROUND JOINT
AIR HAMMER COUPLING

Compact Type, Style XLD-41, ½" and ¾". Heavy Type, Style XHD-52, ¾" and 1"

One of the most satisfactory and economical couplings you can buy for every kind of pneumatic tool work. Copper insert in spud fits accurately rounded head of steel stem, forming soft-to-hard metal seal that is easily and quickly made and is not affected by severest operating conditions. Cadmium plated—rustproof.



"GJ-BOSS"
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Compact Type, Style XLB-61, ½" and ¾". Heavy Type, Style XHB-72, ¾" and 1"

Same as the "GJ-DIXON" coupling described above, except that it is furnished with the sturdy malleable iron "BOSS" Interlocking Clamp—a feature that makes this the strongest, safest coupling you can buy for air tool service.

Carried in Stock by Leading Rubber Manufacturers and Jobbers

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